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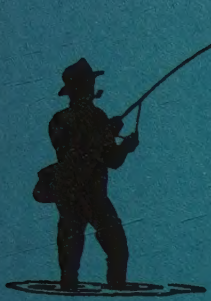

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SPORT FISHERY ABSTRACTS

Vol. 12, No. 3, 1967

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DEPARTMENT OF THE INTERIOR
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BUREAU OF SPORT FISHERIES AND WILDLIFE

DEPARTMENT OF THE INTERIOR

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BUREAU OF SPORT FISHERIES AND WILDLIFE

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SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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Washington, D.C. 20240

9288. Leong, Roderick (Bur. of Commercial Fisheries, Calif. Current Resources Lab., La Jolla, Calif.). 1967. EVALUATION OF A PUMP AND REELED HOSE SYSTEM FOR STUDYING THE VERTICAL DISTRIBUTION OF SMALL PLANKTON. U.S. Fish and Wildlife Service Special Scientific Report—Fisheries 545. 9 p.

The system consists of a submerged pump that delivers water from sampling depth to inboard filters through a long hose. It features a special winch that can store more than 120 m of collapsible, large-diameter hose. Sources of error due to fragmentation and dispersion of organisms during passage through the system, and escapement through the strainers, were examined. Fragmentation may be excessive if animals are fragile or longer than 5 mm. Organisms that enter the system simultaneously may become widely dispersed but most remain together. Strainers of 100μ mesh (bar measure) retain organisms as narrow as 100μ. The capabilities of the pump were illustrated by its use in obtaining vertical profiles of abundance of eggs and larvae of sardines (Sardinops caerulea) and of chaetognaths and doliolids at one station. The eggs and larvae were clearly restricted to the upper mixed layer and upper part of the thermocline. Numbers of chaetognaths increased and numbers of doliolids decreased with increasing depth. The advantages and limitations of the pump for studying vertical distribution are discussed. (Auth.)

9289. Thompson, Clark S., William Spencer Davis, and Emil Slatick (Bur. of Commercial Fisheries, Fish-Passage Research Program, Seattle, Wash.). 1967. RESPONSE OF MIGRATING ADULT SALMONIDS TO VERTICAL AND HORIZONTAL RECTANGULAR ORIFICES AT TWO DEPTHS. U.S. Fish and Wildlife Service Special Scientific Report—Fisheries No. 547. 8 p.

The response of migrating adult salmonids to various placements of rectangular fishway orifices was studied at the Fisheries-Engineering Research Laboratory, on the Washington end of Bonneville Dam. Chinook salmon (Oncorhynchus tshawytscha), steelhead trout (Salmo gairdneri), and coho salmon (O. kisutch) approaching a vertical wall had the alternatives of entering rectangular orifices positioned either horizontally or vertically and either shallow (3 feet) or deep (9 feet). The responses of the three species to the various orifice conditions are analyzed. More migrants passed through shallow orifices than deep orifices, and more salmonids entered vertical orifices than horizontal orifices. (Authors)

9290. Bulkley, Ross V. (Oregon State Game Comm., Research Div., Corvallis, Oreg.). 1967. FECUNDITY OF STEELHEAD TROUT, Salmo gairdneri, FROM ALSEA RIVER, OREGON. J. Fish. Res. Bd. Canada, 24(5): 917-926.

In a sample of 73 females of winter steelhead, Salmo gairdneri Richardson, from the 1965-66 spawning run in the Alsea River, Oregon, egg size and egg number were correlated with body length. Alsea steelhead produced approximately 32% fewer eggs than females from Trinity River, California, and 51% less than fish of similar size from Scott Creek, California. (Auth.)

9291. Faber, Daniel J. (Lab. of Limnology, Univ. of Wisconsin, Madison, Wisc.). 1967. LIMNETIC LARVAL FISH IN NORTHERN WISCONSIN LAKES. J. Fish. Res. Bd. Canada, 24(5): 927-937.

The open water of two northern Wisconsin lakes was sampled for larval fish at night with fine-mesh conical townets. Those collected were identified to genus or species and enumerated. The majority of larval fish were captured in the limnetic region but a few never strayed from the littoral region. The seasonal changes of the limnetic species were similar for the two lakes and 3 years of study. Their abundance varied greatly from year to year but yellow perch, sunfish, and black crappies always dominated. (Auth.)

9292. Black, Edgar C., and S.J. Tredwell (Dept. of Physiology, Univ. of British Columbia, Vancouver, B.C., Canada). 1967. EFFECT OF A PARTIAL LOSS OF SCALES AND MUCOUS ON CARBOHYDRATE METABOLISM IN RAINBOW TROUT (Salmo gairdneri). J. Fish. Res. Bd. Canada, 24(5): 939-953.

This study was undertaken to determine what part partial scaling and partial

desliming might play in the survival of trout. Carbohydrate metabolism in these trout was studied and in addition, hemoglobin levels and red cell volumes were studied to serve as indicators of osmotic shifts of water. Increases in lactate were minimal and occurred during the first few hours of holding after the removal of 1/6 to 1/4 of the scales. There were slight changes in hemoglobin levels and red cell volumes which appeared to coincide with activity as reflected by lactate levels. There was a three- to fourfold increase in the blood glucose level of partially scaled fish. Liver glycogen levels dropped to 1/7 of the air-dipped control value for fish that had been 1/6 scaled and held in holding baskets for a period of 140 hours. Only one mortality occurred in all the experiments. The following conclusions were reached. Partial loss of scales or mucous does not result in the death of rainbow trout (Salmo gairdneri). Partial scaling or desliming of the fish was accompanied by a significant increase in blood glucose ($p < 0.05$). (Authors)

9293. Johnston, C.E., and J.G. Eales (Dept. of Biology, Univ. of New Brunswick, Fredericton, N.B., Canada). 1967. PURINES IN THE INTEGUMENT OF THE ATLANTIC SALMON (Salmo salar) DURING PARR-SMOLT TRANSFORMATION. J. Fish. Res. Bd. Canada, 24(5): 955-964.

During the parr-smolt transformation in Atlantic salmon, silvery materials were found beneath the scales (scale layer) and deep in the dermis adjacent to the muscle (skin layer). Both layers were thicker in smolts than in parr and both layers contained guanine and lesser amounts of hypoxanthine. Changes in levels of guanine, hypoxanthine, and the ratio between them (G/H) were measured from late December to late May on 2-year-old parr held in the laboratory under natural pnotoperiods and at temperatures varying from 6.0 in December to 9.5 C in late May. The change from parr to silvery parr during February and March accompanied sharp increases in guanine, hypoxanthine, and G/H values in the skin layer with less marked increases in the scale layer. The change from silvery parr to smolts during April and May accompanied sharp increases in guanine, hypoxanthine, and G/H values in the scale layer but no change occurred in the trend already established in the skin layer. Parr held all winter under stream conditions and examined in early April possessed purine levels and G/H ratios in the skin and scale layers comparable to those in laboratory fish during the previous December. Silvery parr captured migrating seaward in early June had purine levels and G/H ratios in the scale layer similar to those in laboratory smolts in late May but skin guanine values were much lower and the G/H ratio in the skin was extremely low. (Authors)

9294. Martin, N.V., and F.K. Sandercock (Ontario Dept. of Lands and Forests, Maple, Ont., Canada). 1967. PYLORIC CAECA AND GILL RAKER DEVELOPMENT IN LAKE TROUT, Salvelinus namaycush, IN ALGONQUIN PARK, ONTARIO. J. Fish. Res. Bd. Canada, 24(5): 965-974.

Counts of pyloric caeca and gill rakers were made on lake trout (Salvelinus namaycush) in three Algonquin Park lakes where the trout were dependent on plankton for food in varying degrees. In 798 trout from the three lakes, pyloric caeca counts ranged from 105 to 210 and varied with the size of trout. There was no association between numbers of caeca and type of food eaten. Gill raker counts were made on 930 lake trout. Numbers of rakers are not related to size or sex of lake trout in the sample. Gill raker counts ranged from 17 to 26 in the combined populations. An association exists between the numbers of gill rakers, their length, and the amount of plankton eaten by the lake trout. Accessory gill rakers on the medial surface of the gill arch are described. The number and development of these rakers were associated with the amount of plankton eaten by the lake trout. (Authors)

9295. McLaren, Ian A. (Marine Sciences Centre, McGill Univ., Montreal, Quebec, Canada). 1967. INTRODUCTION TO BIOLOGICAL STUDIES OF OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND. J. Fish. Res. Bd. Canada, 24(5): 975-980.

Ogac Lake is the almost isolated head of a fiord, Ney Harbour, on the south

coast of Frobisher Bay, N. W. T. Earlier knowledge of the lake is summarized, a brief account is given of expeditions to the lake in 1957 and 1962, and the scope of the studies is outlined. (Auth.)

9296. McLaren, Ian A. (Marine Sciences Centre, McGill Univ., Montreal, Quebec, Canada). 1967. PHYSICAL AND CHEMICAL CHARACTERISTICS OF OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND. J. Fish. Res. Bd. Canada, 24(5): 981-1015.

Ogac Lake is the small (148 ha) landlocked head of a fiord with three distinct basins. It receives highest spring tides (maximal range 12 m, as high as 1.2 m above lake level) monthly during the open-water season through a narrow entrance. The predictable inflows displaced about one-quarter of the lake's volume in 1957. The lake is meromictic, fresh at the surface and 28 $^{o}/_{oo}$ salinity at depth. Some 55 kg/m^2 salt lost in surface outflow in summer was more than restored by the tides by the end of 1957. Deep salinities did not change between 1951 and 1962. Vertical attenuation of light is adequately accounted for by chlorophyll alone. The lake is much warmer than the nearby sea. Temperature inversions are caused by cold tidal water and perpetuated by vertical stability. The gross annual heat budget in 1957 was 22,000 cal/cm^2, about the same as in the nearby sea, but higher than in a freshwater lake. Heating from below a few meters to 30 m can be accounted for by radiation alone. About 20% of radiation reaching the bottom subsequently appeared as heat in the water immediately overlying the bottom, thus implying restricted horizontal transfer. Oxygen was absent below 25-32.5 m, which may approximate the compensation level in this and similar lakes. Oxygen differences between basins are partly controlled by morphometry. Distinct oxygen minima in 1957 were associated with temperature minima and caused by concentrations of zooplankton. Vertical distribution of pH parallels that of oxygen. Specific alkalinities seem slightly higher than in normal seawater. Phosphate showed a distinct and stable minimum just above the anoxic layer and was as high as 14.3 µg-at/liter within that layer. Nitrate was relatively low and maximal just above the anoxic layer. Although nutrient levels seemed partly related to morphometry in the three basins, no evidence of nutrient enrichment of bottom water was found in late summer. The tides contribute negligible nutrients to the lake. The character of Ogac Lake compared with similar lakes derives from the great tidal amplitude and narrow connection with the sea, as well as from its small size and sheltered setting. (Auth.)

9297. Slack, H. D. (Dept. of Zoology, Univ. of Glasgow, Glasgow, Scotland). 1967. A BRIEF SURVEY OF THE PROFUNDAL BENTHIC FAUNA OF LAKES IN MANITOBA. J. Fish. Res. Bd. Canada, 24(5): 1017-1033.

The profundal benthic fauna of nine lakes lying along the margin of the Precambrian Shield in the Province of Manitoba was investigated during August 1963, and is described with particular attention to the midges (Diptera: Chironomidae). Comparison with a Scottish lake, similarly situated with respect to Precambrian rocks, showed no close agreement in the distribution of species of Chironomidae. This can be credited to differences in the Palaeozoic rocks adjoining the Precambrian. Chironomus tentans and C. decorus were most numerous and most frequent at water depths up to 15 m whereas C. anthracinus and Chironomus sp. A were generally in water over 20 m. In Falcon, Reed, and Morton lakes, C. anthracinus tended to be more successful where sediments contained appreciable amounts of allochthonous debris and to give way to Chironomus sp. A where sediments were autochthonous. (Auth.)

9298. Vladykov, Vadim D., and W. I. Follett (Dept. of Biology, Univ. of Ottawa, Ottawa, Ont., Canada). 1967. THE TEETH OF LAMPREYS (PETROMYZONIDAE): THEIR TERMINOLOGY AND USE IN A KEY TO THE HOLARCTIC GENERA. J. Fish. Res. Bd. Canada, 24(5): 1067-1075.

9299. Bams, R. A. (Fish. Res. Bd. of Canada Biological Station, Nanaimo, B. C., Canada). 1967. DIFFERENCES IN PERFORMANCE OF NATURALLY AND ARTIFICIALLY PROPAGATED SOCKEYE SALMON MIGRANT FRY, AS MEASURED

WITH SWIMMING AND PREDATION TESTS. J. Fish. Res. Bd. Canada, 24(5): 1117-1153.

Two methods of performance testing were developed to measure differences in stamina in four groups of sockeye migrant fry, all of the Lakelse Lake (Skeena River, B. C.) stock. The four groups differed only in methods of incubation: one group was naturally propagated, the other three artificially. The results of the swimming performance tests and the vulnerability to predation tests agree closely, and analysis shows that the key factor responsible for differences in performance is size of the fish. Ranked in decreasing order of performance these four groups rate as follows: naturally propagated fish, fish incubated in gravel from time of hatching, fish incubated in gravel only for the last few weeks as premigrants, and fish that spent their entire incubation period without gravel in hatchery baskets. Independent of size is the influence of condition (K-factor) of the fish, optimum performance occurring at the time of almost complete yolk absorption. Of the two methods the swimming performance test was found to be more sensitive and is recommended as a tool for comparative "quality testing" of fish stocks. (Auth.)

9300. Buss, Keen, and Jack Miller (Penn. Fish Comm., Benner Spring Fish Research Station, Bellefonte, Pa.). 1967. INTERSPECIFIC HYBRIDIZATION OF ESOCIDS: HATCHING SUCCESS, PATTERN DEVELOPMENT, AND FERTILITY OF SOME F_1 HYBRIDS. Bureau of Sport Fisheries and Wildlife Technical Paper 14. 30 p.

Extension of the range of most of the esocid species has posed a problem of interspecific hybridization which could be harmful to indigenous pike species. In this paper the literature is reviewed and the success of reciprocal crosses is recorded, including drawings and photographs showing the development of progeny. Fertility of some F_1 hybrids was investigated since this too would reflect on the biological relationship of the species. Five Esocidae--muskellunge (Esox masquinongy Mitchill), northern pike (Esox lucius Linnaeus), chain pickerel (Esox niger LeSueur), redfin pickerel (Esox americanus americanus Gmelin), and grass pickerel (Esox americanus vermiculatus LeSueur)--were used as parent species to make 20 reciprocal crosses. Of these, 17 were successful to some degree in producing progeny. The young were maintained from 1 to 4 years, and the fertility of six reciprocal hybrids was established. It appears that even though many species can be artificially hybridized, isolating mechanisms may prevent or retard hybridization under natural conditions. (Authors)

9301. Pfeiffer, Peter W. 1967. SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF BULLOCK PEN LAKE. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 29. 22 p.

Physical, chemical, and biological studies were conducted on Bullock Pen Lake from 1958 through 1962. A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was evident by mid-May, at which time the thermocline was located between 6 and 19 feet. Autumnal mixing was completed by November when a near homothermic condition was found. Mean monthly dissolved oxygen profiles show this characteristic to be present in adequate amounts (for fish survival) to a depth of 10 feet during all sampling periods. It became void in the lower depths during June, July, and August. Ranges for alkalinity, total phosphates, pH, and free carbon dioxide are given. Aquatic vegetation studies showed that dense beds of the curly pondweed, Potamogeton crispus L., were produced and covered 17% of the lake in 1960. Population studies indicated an excellent fish population. The average standing crop increased from 115.8 pounds per acre in 1958 to 193.4 pounds per acre in 1962. Ample reproduction of both forage and piscivorous species was noted each year with a very heavy spawn of white crappie occurring in 1958. The channel catfishes reached harvestable size in 1961, five years after the initial stocking. The creel survey studies showed a decreasing harvest from 1958 to 1961, however, in 1962 the harvest increased 50% over that recorded in the first year. The channel catfish harvest was excellent with increased quality and quantity being recorded each year. Other species generally reflected the strength of their year classes. (Auth.)

9302. Pfeiffer, Peter W. 1967. SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF CARPENTER LAKE. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 30. 19 p.

Physical, chemical, and biological studies were conducted on Carpenter Lake from 1960 through 1963. A bathymetric map of the lake is presented. Other physical data are given which include surface area, miles shoreline, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was evident by mid-May, at which time the thermocline was located between 6 and 19 feet. Fall circulation was complete by November, when a homothermic condition was found. Mean monthly dissolved oxygen profiles show this variable to be present above 3.6 ppm, to a depth of 10 feet, during all sampling periods. It became void in the lower depths during July, August, and September. Ranges for total alkalinity, total phosphates, pH, and free carbon dioxide are given. Aquatic vegetation studies showed that dense beds of the curly pondweed, Potamogeton crispus L., were produced in 1960. An average of 73 stems per square foot of sampled area were found. Population studies indicated a decreasing fish population. The standing crop dropped from 271.5 pounds per acre in 1960 to 88.4 pounds per acre in 1963. The largemouth bass and bluegill spawned each year from 1960 through 1963. The magnitude of the spawn varied from year to year but did not always relate to the density of the standing crop, which may have acted as a suppressent in 1960. The creel survey studies showed an increasing harvest from 32.1 pounds per acre in 1960 to 69.8 pounds per acre in 1963. No channel catfishes were recorded in the survey during the four years of study. (Auth.)

9303. Pfeiffer, Peter W. 1967. SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF ELMER DAVIS LAKE. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 33. 21 p.

Physical, chemical, and biological studies were conducted at Elmer Davis Lake from 1958 through 1964. A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was usually evident by mid-May when the thermocline extended from 7 to 15 feet. Fall overturn was complete by early December. Mean monthly dissolved oxygen profiles show this characteristic to be present in amounts above 4 ppm to a depth of 10 feet during all sampling periods. Less than 2 ppm were found in the lower depths during June, July, August, and September. Annual maximum, mean, and minimum values are given for total alkalinity, total phosphates, pH, and free carbon dioxide. Population studies indicated an improving fish population from 1960 to 1964. The average standing crop increased from 36 pounds per acre in 1960 to 131 pounds per acre in 1964. There were approximately 40 pounds per acre more fish of a size desirable to the angler in 1964 than there were in 1960. Creel survey studies indicated an increasing harvest from 1960 to 1964. There were approximately 35 pounds per acre more fish harvested in 1964 than were creeled in 1960. The fertilization studies indicated a substantial increase in the quality and quantity of the fishery during the years when an inorganic fertilizer (20-20-5) was applied at the rate of 40 pounds per acre per application. (Auth.)

9304. Pfeiffer, Peter W. 1967. SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF WASHBURN LAKE. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 34. 14 p.

Physical, chemical, and biological studies were conducted at Washburn Lake from 1962 through 1965. A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was usually evident by early May when the thermocline extended from 7 to 11 feet. Fall overturn was complete by mid-October. Mean monthly dissolved oxygen profiles show this characteristic to be present in amounts adequate for fish survival (2.6 ppm) to a depth of 10 feet during all months. It became void in the lower depths from July through September. Annual maximum, mean,

and minimum values are given for total alklainity and total phosphates. Population studies indicated a relatively stable fish population. A low standing crop of 68 pounds per acre was recorded in 1962, and by 1965 this had dropped to 53 pounds per acre. The fertilization studies showed no substantial increase in the production of the lake during the first three years of fertilization. This was related to the dense growth of weeds, mainly Najas quadalupensis (Spreng) Morong, which utilized the nutrients that were intended for plankton production. (Auth.)

9305. Charles, James R. 1967. THE BUCKHORN RESERVOIR FISHERY DURING THE FOURTH, FIFTH, AND SIXTH YEARS OF IMPOUNDMENT. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 46. 40 p.

The standing fish crop in Buckhorn Reservoir during 1964 and 1965, the fourth and fifth years of impoundment, averaged between 62 and 63 pounds per acre. Carrying capacity was apparently reached during the second year of impoundment, when an 89-pound per acre biomass was recorded, and was duplicated the following year. The percentage of the biomass composed of harvestable-size fish appears to have stabilized between 56 and 59%, considerably higher than any previous A_t value. The much sought-after game fishes were more abundant (310 vs. 288, per acre) in 1965 than in the previous year. Concurrently, their biomass also increased from 10 to 18 pounds, per acre. Game fishes of harvestable-size numbered 5 per acre in 1964; their number had risen to 9 per acre by 1965. The continued scarcity of forage fishes (0.6 to 0.7 pounds per acre), accentuated by the unique absence of gizzard shad in this reservoir, was the chief factor responsible for the low productivity. The Cumberland Lake strain of threadfin shad, possibly more winter-hardy than other strains, was introduced into Buckhorn Reservoir in the spring of 1964 and re-introduced in the spring of 1966. Spot-sampling in the fall of 1964 disclosed the presence of a tremendous spawn, indicating that this species had been very successful in saturating an uncontested niche, consequently no restocking was done in 1965. The unforeseen absence of threadfin in 1965, discovered during routine population sampling, was attributed to migration from the reservoir during the fall drawdown, rather than to winter-kill, no instances of the latter having been observed. Inexplicably, the adult threadfin shad stocked in 1966 failed to reproduce. Fishing pressure at Buckhorn Reservoir between April 1 and October 31, 1964 amounted to 64,275 man-hours, or 51 man-hours per acre. The following year, over the same 7-month period, the pressure was 58,828 man-hours, or 47 man-hours per acre. The survey in 1966 was expanded to include March, and during that 8-month period the fishing pressure was 49,965 man-hours, or 40 man-hours per acre. The yield or harvest in 1964 was 72 fish and 18 pounds per acre. In 1965 it was 68 fish and 21 pounds per acre. In 1966 the harvest was 62 fish and 23 pounds per acre. The annual average catch rate for the 3 years was 1.4, 1.5, and 1.5 fish per man-hour. Fish caught at Buckhorn annually averaged 0.25, 0.31, and 0.37 pound. Fisherman success was high: 78% of all anglers caught fish in 1964, 68% were successful in 1965, and again 78% were successful in 1966. Other characteristics of the fishery (composition of the catch, fisherman intent, etc.) are described and evaluated in the report. Water quality determinations (temperature, dissolved oxygen, and total alkalinity) normally were made once each month at three widely separated stations until isothermic conditions prevailed. Temperatures found in relation to the various strata (at 5-foot intervals) are described and are shown in tabular form. Dissolved oxygen was abundant, or at least adequate for the normal needs of fishes, seldom being absent even near the bottom. The total alkalinity of this mountain reservoir, reflecting the nature of the drainage basin parent material, was relatively low, ranging from the high teens to the low twenties (ppm, as $CaCO_3$). (Auth.)

9306. Wolf, Ken. 1966. VIRAL HEMORRHAGIC SEPTICEMIA OF RAINBOW TROUT. Bureau of Sport Fisheries and Wildlife Fish Disease Leaflet 6. 4 p.

9307. Wolf, Ken. 1966. BACTERIAL KIDNEY DISEASE OF SALMONID FISHES. Bureau of Sport Fisheries and Wildlife Fish Disease Leaflet 8. 4 p.

9308. Miller, Donovan. 1967. CAN BRITISH COLUMBIA'S WATER USERS LEARN TO LIVE TOGETHER? Western Fisheries, 73(6): 24, 26, 28, 30, 32.

The salmon fishery is in danger of becoming "the undesirable stepchild of our society" in terms of water use, because of the tremendous pressure exerted by other water-using industries in British Columbia's current industrial boom. In a paper presented to the 17th annual Natural Resources Conference in Victoria, Canadian Fishing Company president Don Miller presented the case for fisheries in a succinct, widely-quoted speech. The paper takes the form of an answer to the main address of the conference made by H. D. DeBeck, Comptroller of Water Rights of the British Columbia Department of Lands, Forests and Water Resources, who gave a comprehensive summary of how British Columbia's water resources are administered, and what rights each of the many users have. Miller takes issue with several of DeBeck's conclusions, including the contention that "low-value in-channel use of water (e. g. fisheries) will give way to high-value use".

9309. Kondo, Heihachi, Yoshimi Hirano, Nobuyuki Nakayama, and Makoto Miyake. 1965. OFFSHORE DISTRIBUTION AND MIGRATION OF PACIFIC SALMON (GENUS Oncorhynchus) BASED ON TAGGING STUDIES (1958-1961). Int. North Pac. Fish. Comm. Bulletin 17. 213 p.

Out of a total of 6,120 tagged sockeye salmon (maturing and immature), 483 (7.9%) were recovered. Most of the recoveries were made in Bristol Bay or on the high seas. Little new information was obtained on the distribution and migration of sockeye originating on the Asian continent. It was confirmed, however, that both maturing and immature Bristol Bay sockeye are distributed in the northern North Pacific between 167°E and 149°W in early spring and that they begin migrating in the spring and enter the Bering Sea as the season progresses. It was also found that most maturing Bristol Bay sockeye probably spend the winter and early spring primarily in the area south of the eastern Aleutian Islands and Alaska Peninsula. Out of a total of 9,238 tagged chum salmon (maturing and immature), 332 (3.6%) were recovered. Most of the recoveries were from the high seas and the Asian coast. It was found that maturing and immature chum salmon of Asian origin have a much wider distribution in the ocean than chum of North American origin. The distribution and migration of various stocks of maturing Asian chum salmon were studied extensively. It was found that the chum salmon which form the autumn run to the Hokkaido area are distributed as far east as the area south of the Alaska Peninsula in the spring of the year in which they start their spawning migration. This is of particular interest since the maturing chum salmon which form the autumn run to the Amur River area are distributed mainly in a small area east of the Kuril Islands. Out of a total of 9,628 tagged pink salmon (all maturing), 362 (3.8%) were recovered. Most of the recoveries were from the high seas and the Asian coast. The general distribution and migration of individual stocks of pink salmon from the Asian continent were studied extensively. It was confirmed that the ocean distribution of maturing pink salmon originating from the Karaginski-Oliutorski area generally extends further eastward than that of the pink salmon from other areas of Asia. They extend towards the eastern Bering Sea and to near the tip of the Alaska Peninsula in the Pacific in May and June. On the other hand, maturing pink salmon of northwestern Alaskan origin are distributed as far west as the vicinity of Adak Island in their good (odd-numbered) years; their ocean distribution in poor (even-numbered) years is unknown because of the scarcity of fish. Out of a total of 1,143 tagged maturing coho salmon, 62 (5.4%) were recovered. Evaluation of the results of both the Japanese and United States tagging studies gives some general information on the distribution and migration of coho salmon. Portions of stocks of maturing coho salmon from both continents (Asia and North America) were shown to intermingle in one year in the waters south of the central Aleutian Islands during mid-summer. Maturing coho salmon originating from the northern Okhotsk Sea tend to be distributed in the southwestern sector of the northwestern North Pacific, while those from East Kamchatka extend to the northeastern part of the northwestern North Pacific. This generalization can also be applied to maturing chum salmon (except the autumn run to the Hokkaido area) and to pink salmon. (Authors)

9310. Cory, Robert L. (U.S. Geological Survey, Wash. D.C.). 1967. EPIFAUNA OF THE PATUXENT RIVER ESTUARY, MARYLAND, FOR 1963 AND 1964. Chesapeake Science, 8(2): 71-89.

Methods of collection and analysis of epifaunal communities from six stations in the Patuxent estuary are described. The stations were distributed from Solomons near the mouth of the estuary, upstream to Lower Marlboro, near the limit of salt water intrusion. Species composition and abundance, seasons of attachment, and production of the epifaunal community were determined on material collected from panels submerged for 1-, 3-, and 12-month periods covering the years 1963 and 1964. Salinity was highest downstream, as was the number of species. Salinity decreased rapidly between the Patuxent River Bridge station and Lower Marlboro, where the number of species was reduced to half. Seasons of attachment corresponded with seasonal temperature changes, with the greatest attachment taking place during the summer months. Over 40 species were identified with 7 of them comprising the bulk of the biomass produced. For the 7 most productive species, seasons of attachment and total numbers collected from areas of one square decimeter from monthly and quarterly panels from each station are shown. The seven species were the barnacle Balanus improvisus; the tunicate, Molgula manhattensis; the hydroids, Cordylophora lacustris and Bimeria franciscana; the amphipod, Corophium lacustre; the anemone Sagartia leucolena; the tubeworm, Polydora ligni. Their respective importance varied with seasons of attachment and location. Comments on the distribution and abundance of the less significant forms are included. Dry and ash-free dry weight (organic carbon) production of the epifaunal community varied from month to month depending on the seasons of attachment of the various species. The highest production for a single month was observed at the upriver station, Lower Marlboro, where barnacles and amphipods produced 2,754 $g/m^2/30$ days dry weight and 351 $g^c/m^2/30$ days organic weight during August 1963. At the same station, barnacles, amphipods, and hydroids produced, on quarterly panels, the highest yearly average weight of about 1,150 $gc/m^2/yr$ organic carbon and on monthly panels, about 6,500 $g/m^2/yr$ dry weight or about 3.5 times the least organic weight and 8 times the least dry weight produced at the downriver Station, Queentree Landing. (Auth.)

9311. Marshall, Harold G. (Old Dominion College, Norfolk, Virginia). 1967. PLANKTON IN JAMES RIVER ESTUARY, VIRGINIA. I. PHYTOPLANKTON IN WILLOUGHBY BAY AND HAMPTON ROADS. Chesapeake Science, 8(2): 90-101.

The James River and the Chesapeake Bay meet in the waters of Hampton Roads, Virginia. A study was made of the phytoplankton in Hampton Roads and adjoining Willoughby Bay from January 1964 to May 1965. The composition and seasonal variations of total phytoplankton and major species are described for three stations in this area. The major phytoplankters were neritic north temperate species. The diatoms, chiefly Skeletonema costatum, Asterionella japonica, and Nitzschia pungens atlantica, composed the winter and early spring maxima. Diatoms and large numbers of phytoflagellates were the major constituents in collections during summer and fall. The fluctuation in the composition and vertical distribution of phytoplankton is discussed for a 24-hour period, at one station, in Hampton Roads, where Skeletonema costatum was the most numerous plankter in all of the samples. (Auth.)

9312. Nichols, Paul R., and Robert Victor Miller (Bur. of Commercial Fisheries, Biological Lab., Beaufort, N.C.). 1967. SEASONAL MOVEMENTS OF STRIPED BASS, Roccus saxatilis (Walbaum), TAGGED AND RELEASED IN THE POTOMAC RIVER, MARYLAND, 1959-61. Chesapeake Science, 8(2): 102-124.

During 1959-61, 8,973 striped bass, Roccus saxatilis (Walbaum), were tagged and released in the Potomac River, Maryland. Of the 3,344 (37.3%) recaptured, 98.0% were taken in the Maryland part of Chesapeake Bay and its tributaries, 0.5% were recovered in the Virginia part of Chesapeake Bay and its tributaries, and 1.5% were taken outside Chesapeake Bay along the Atlantic coast from Delaware to Nova Scotia. In the wintering season (November-March), the tagged fish were concentrated in the lower river and were very active, traveling several miles a

day. In the spawning season (April-June), they mostly moved upstream to the spawning grounds where the tagged fish remained for most of the season, and then dispersed downstream to the lower river and into Chesapeake Bay. In the feeding season (July-October), tagged fish were scattered throughout Chesapeake Bay and tributaries. Some striped bass which overwintered in the Potomac were recaptured during the following spawning season in other Chesapeake Bay tributaries, and fish from the Potomac contributed materially to the stocks of striped bass along the northeast Atlantic coast. Spawning striped bass return to the same spawning grounds in successive years. Recaptures of tagged fish by date and location during the wintering, spawning, and feeding seasons, and the miles traveled and days at large by individuals, are tabulated. (Authors)

9313. Dovel, William (Univ. of Maryland, Natural Resour. Inst., Chesapeake Biological Lab., Solomons, Md.). 1967. FISH EGGS AND LARVAE OF THE MAGOTHY RIVER, MARYLAND. Chesapeake Science, 8(2): 125-129.

Bi-weekly samples of fish eggs and larvae were collected for a 15-month period from the Magothy River. Samples were taken simultaneously from surface and bottom waters with one-meter plankton nets. Altogether 17 species of fish eggs and larvae were collected. Their seasonal occurrence, distribution patterns, and abundance are presented and discussed. (Auth.)

9314. Trent, W. Lee (Bur. of Commercial Fisheries, Biological Lab., Galveston, Texas). 1967. ATTACHMENT OF HYDROFOILS TO OTTER BOARDS FOR TAKING SURFACE SAMPLES OF JUVENILE FISH AND SHRIMP. Chesapeake Science, 8(2): 130-131.

Regular otter trawl boards were converted to surface trawl boards by attaching hydrofoils to the top edge of the boards. The conversion is simple and inexpensive. The converted otter boards were used to change a bottom trawl into a surface trawl that can be fished from one boat in the same manner as bottom gear. This trawl was efficient in sampling juvenile alewife (Alosa pseudoharengus), blueback herring (A. aestivalis), and brown shrimp (Penaeus aztecus). (Auth.)

9315. Lopinot, A. C. 1967. POND FISH AND FISHING IN ILLINOIS. Illinois Dept. of Conservation Fishery Bulletin No. 5. 62 p.

"Good fishing doesn't just happen. It's more than just building a dam, waiting for rain, stocking some fish, and living happily ever after. Fish are a crop, and a pond must be managed and cultivated to provide good harvests." A good handbook for the farmer or landowner who wants to have fishing from his Illinois pond. It discusses briefly construction, fish species, stocking, harvest, weeds, fertilization, common fish diseases and commercializing. The illustrations and suggestions should prove adequate for most of the problems in managing ponds in Illinois and surrounding states.

9316. Beardsley, Grant L., Jr. 1967. AGE, GROWTH, AND REPRODUCTION OF THE DOLPHIN, Coryphaena hippurus, IN THE STRAITS OF FLORIDA. Copeia, No. 2. pp. 441-451.

The dolphin grows rapidly throughout its life. Check marks believed to be annuli were formed from November through February. Average growth was 725 mm fork length the first year and 450 mm the second year. One older fish belonged to age-group III (1,425 mm long), and another to age-group IV (1,525 mm). A male dolphin in the reef tank of the Miami Seaquarium, Miami, Florida, grew from about 0.5 kg (1 lb.) to 16.3 kg (36 lb) in about eight months. Maximum life span is probably about four years. Male dolphin longer than about 450 mm were heavier than females of the same length. Reproduction was studied by gross observation of the gonads, measurements of egg diameters, and counts of maturing eggs. Changes in the gonads through the year indicated that the spawning season in the Florida Current extends from November through July and is at its peak in March. Female dolphin begin to mature at a slightly larger size. Female dolphin produce 80,000-1,000,000 eggs at each spawning and spawn twice (perhaps as many as three times) per year. (Auth.)

9317. Ferguson, Denzel E., and C. Phillip Goodyear (Dept. of Zoology, Mississippi State Univ., State College, Miss.). 1967. THE PATHWAY OF ENDRIN ENTRY IN BLACK BULLHEADS, Ictalurus melas. Copeia, No. 2. pp. 467-468.

9318. Childers, William F., and George W. Bennett (Illinois Natural History Survey, Urbana, Ill.). 1967. EXPERIMENTAL VEGETATION CONTROL BY LARGEMOUTH BASS — TILAPIA COMBINATIONS. Jour. of Wildlife Management, 31(3): 401-407.

Tilapia mossambica survived and reproduced in a central Illinois pond during the period May 15 - September 30, 1962-65. In normal years, water temperatures are believed to have exceeded 60° F (15.6° C) during this period. This species died when exposed for extended periods to water temperatures of 55° F (12.8° C) and below, although it survived for short periods with temperatures in the 40's. A stocking of 58 tilapias weighing 1.6 lb/acre increased to 11,000 fish weighing 387 lb/acre when placed in a pond by themselves and left for a single growing season (May-October). When varying numbers of largemouth bass were added, the tilapia population lost ground with 826 bass/acre, increased to a limited extent with 91 bass/acre, and expanded 132 times with 37 bass/acre. Predator-prey relationships were probably influenced by the relative abundance of crayfish and tadpoles in the pond. When more than 1,000 tilapias/acre were present, they were able to eliminate algae and rooted submersed aquatic plants during 1962 and 1965. Vegetation density was only moderately affected during 1964 when about 164 tilapias/acre were present. Tilapias by themselves would be useful in artificial lakes and ponds where aquatic vegetation problems are common, aesthetic values are of primary importance, and summer water temperatures are suitable. (Authors)

9319. Stevens, Robert E., and Jefferson C. Fuller, Jr. 1965. A PRELIMINARY REPORT ON THE USE OF HORMONES TO OVULATE STRIPED BASS, Roccus saxatilis (Walbaum). Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 222-235.

Of 162 female striped bass treated with hormones during the 1962 spawning season, 44 (27.2%) were induced to ovulate. Of several preparations used, chorionic gonadotropin proved to be very effective while follicle stimulating hormone was slightly effective. Of 36 million striped bass eggs put into the hatchery only 7.3 percent hatched. The cause of mortality is largely unknown. (Authors)

9320. Kelly, H. D., and Ray Allison (Alabama Dept. of Conservation, Div. of Fish and Game, Montgomery, Ala.). 1965. OBSERVATIONS ON THE INFESTATION OF A FRESH WATER FISH POPULATION BY A MARINE COPEPOD (Ergasilus lizae Krøyer 1863). Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 236-239.

Lake Shelby, an 829-acre natural lake, located in Baldwin County at Gulf Shores, Alabama was treated with emulsifiable rotenone in October 1956 to eliminate an undesirable fish population. The lake was restocked with the bluegill sunfish, Lepomis macrochirus; the redear sunfish, Lepomis microlophus; and the largemouth bass, Micropterus salmoides. Subsequent population examinations following restocking revealed in 1958 that a copepod was infesting the gills of the fish. Collection of specimens and identification revealed the copepod to be Ergasilus lizae Krøyer previously reported only from marine hosts. A description and history of Lake Shelby is given. The taxonomy and morphology and observations on the life cycle of Ergasilus lizae are also presented. (Authors)

9321. Louder, Darrell E., and Edward G. McCoy (Fish Div., North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1965. PRELIMINARY INVESTIGATIONS OF THE USE OF AQUALIN FOR COLLECTING FISHES. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 240-242.

Bioassays were conducted with Aqualin, a herbicide manufactured by the Shell Chemical Company, to investigate its possibilities in collecting fishes from lotic waters as well as to determine its relativity to toxicity to five species of fishes. A narrow range of toxicity was found between the largemouth bass, bluegill, bowfin,

mosquitofish, and the fathead minnow. The 24-hour TL_m (median tolerance limit) values ranged from 0.062 to 0.183 ppm at 71° F. Bowfin were the most sensitive fish tested. Aqualin was found to be less toxic than rotenone in short exposures; however, a lethal dose of either was required to effectively repel fishes. It was concluded that there is a narrow range of susceptibility between different species of fishes to Aqualin and that, in no case was it sufficiently wide to indicate any promise for collecting fishes in lotic waters. (Authors)

9322. Copeland, J.B., and Melvin T. Huish (Florida Game and Fresh Water Fish Comm., Leesburg, Fla.). 1965. A DESCRIPTION AND SOME RESULTS OF A FLORIDA STATE-WIDE FISH TAGGING PROGRAM. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 242-246.

During the period 1960-1962 a state-wide fish tagging program employing substantial rewards to sport fishermen for tag returns was conducted in Florida. A total of 19,470 fish including 5,328 largemouth bass were captured, tagged, and released. There were 24.2 percent of the tagged bass, 4.5 percent of the bluegill, 3.8 percent of the shellcracker, and 8.9 percent of the crappie returned. Little difference in returns was noted between fish which were transported prior to release and those which were released into the waters from which they were captured. (Authors)

9323. Lawrence, J.M., H.H. Funderburk, Jr., R.D. Blackburn, and P.G. Beasley (Auburn Univ. Agric. Experiment Station, Auburn, Ala.). 1965. THE STATUS OF DIQUAT AND PARAQUAT AS AQUATIC HERBICIDES. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 247-257.

The chemical and physical properties and phytocidal activity of diquat (1:1'-ethylene-2:2'-bipyridylium cation) and paraquat (1:1'-dimethyl-4:4'-bipyridylium cation) are discussed. Data are presented on the evaluation of herbicidal activity of the various salts of these 2 chemicals under controlled laboratory conditions, in plastic pools, and in earthen ponds. Research indicates that a majority of common submersed and many emergent aquatic weeds may be killed by concentrations of 0.2 to 0.5 ppm cation of these 2 chemicals. Fish toxicity studies indicate a threshold toxic concentration for diquat in excess of 10 ppm cation, and for paraquat in excess of 5 ppm cation. Two new quaternary bipyridyl chemicals, diquat and paraquat, have been subjected to extensive aquatic herbicide evaluation tests for the past 3 years. These tests have been conducted in the laboratory, in plastic pools, and to a limited extent in ponds, lakes, and drainage canals. The herbicidal activity exhibited under these varied conditions has been spectacular. Concentrations needed for aquatic weed control have not shown any harmful effects upon fish present in such treated waters. Since these are relatively new herbicides, this paper includes general information on the chemicals and their development as aquatic herbicides, laboratory and plastic pool evaluations of herbicidal activity on submersed and emergent aquatic plants, toxicity of the various salts to several species of fresh water fish, and results of herbicidal activity in ponds. (Authors)

9324. Crittenden, Edward (Florida Game and Fresh Water Fish Comm., Leesburg, Fla.). 1965. STATUS OF Tilapia nilotica Linnaeus IN FLORIDA. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 257-262.

The Florida Game and Fresh Water Fish Commission's Fishery Division obtained 3,000 Tilapia nilotica fingerlings from Auburn University on August 30, 1961. These were used as brood fish and were stocked in a 3-acre naturally fertile mined-out phosphate pit in Central Florida at the rate of 1,000 per acre. From time of stocking until May 1962, there was an estimated 7 inches of growth. During the latter part of May this pond appeared to go into an over-crowded condition. Twelve ponds totaling 65 acres have been stocked with tilapia from the brood pond. Stocking rates have varied from 2 adults to 1,000 fingerlings per acre. Minimum water temperature at the brood pit last winter was 53° F. Apparently no mortality occurred from this cold. It was estimated that 1,810 pounds of tilapia

were produced per acre in the brood pit during a 369 day period. The fish were not fed and the pond was not fertilized. Tagging results to date from 100 bluegill and 100 tilapia show a return of 23 tilapia and 21 bluegills. The tilapia is thought to have great potential value in Florida as a sport and food fish. (Auth.)

9325. Snow, J.R., R.L. Wilmot, and J.C. Hudson (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1965. TWO DEVICES FOR APPLYING HERBICIDES TO SMALL PONDS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 263-268.

Two boat-mounted machines for applying herbicides or other similar materials to small ponds are described. A dry materials spreader was assembled from three lawn-type fertilizer spreaders. Powered by a small air-cooled gasoline engine the spreader operated effectively to uniformly distribute granular herbicides, lime or similar materials. Distribution of granular material at rates ranging from 100-1,000 pounds per acre was possible. A boat-mounted spray rig employing a 15-foot boom eliminated the need for a two-man crew for treating small ponds with liquid materials. The spraying operation could be controlled by the boat operator once the spray tank has been filled and the sprayer was started. Both of the machines can be assembled from commercially available parts by a good mechanic in a relatively short period of time. (Authors)

9326. Hatcher, Robert M. (Agric. Exper. Sta., Auburn Univ., Auburn, Ala.). 1965. THE ESTIMATION OF CHANNEL CATFISH (Ictalurus punctatus Rafinesque) POPULATIONS IN FARM PONDS FROM CATCH STATISTICS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 270-276.

The Delury Method was used to estimate the number of channel catfish in three ponds of different years from the catch records of 20,790 anglers at the Farm Pond Project, Auburn, Alabama. The ponds were drained, and the accuracy of the estimates was determined. Estimates for each pond were made using the average number of channel catfish caught per angler per hour at intervals of 1 day, 500 angling hours, 800 angling hours, 1,000 angling hours, and one week. The error of these estimates varied between 0.0 and 10.3 percent from the theoretical true number (the total cumulative catch plus the number recovered upon draining). Estimates obtained using the average catch per unit of effort for the different intervals of effort were not significantly different. The assumptions of the Delury Method were investigated. The assumptions of non-recruitment, the taking of a significant proportion of the population, and constant catchability had to be satisfied to achieve estimates of the above accuracy. The assumption of non-competing units of fishing gear and constant fishing pressure apparently did not have to be fully satisfied to achieve estimates of the above accuracy. (Auth.)

9327. King, Willis (Bur. of Sport Fisheries and Wildlife, Washington, D.C.). 1965. THE COOPERATIVE FISHERY UNITS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 276-281.

The purpose of the cooperative fishery and wildlife units, as stated by Congress, is "to facilitate cooperation between the Federal Government, colleges and universities, the States, and private organizations for cooperative unit programs of research and education relating to fish and wildlife and for other purposes." This paper describes only the fishery phase of the program which is now getting underway. The training of fishery biologists for professional employment is considered the primary objective at this stage. The conduct of research is also recognized as having high importance. Limited attention is given to extension-type programs involving preparation of literature, short courses in fishery methods, preparation of exhibits and demonstrations. Each fishery unit is a cooperative venture involving the Bureau of Sport Fisheries and Wildlife, a university, and usually a State fish and game department. A coordinating committee, representing the participating agencies, gives general guidance to each unit by reviewing annual budgets and proposals for research studies. The Bureau pays the salaries and expenses of a leader and assistant leader and supplies limited funds for employment of students and for graduate research projects. The university provides housing, office and

laboratory space, utilities, access to libraries, other special facilities, and stenographic services. The State fish and game department makes its facilities available wherever feasible and contributes a stated amount of money to the university. These things are spelled out in a cooperative agreement. The Bureau plans a total of approximately 15 units for the United States. As of the date of this report, funds have been provided for seven of these. (Auth.)

9328. Barkuloo, James M., and W. Keith Byrd (Florida Game and Fresh Water Fish Comm., Panama City, Fla.). 1965. SELF CONTAINED UNDERWATER BREATHING APPARATUS (SCUBA) AS AN AID IN FISHERIES WORK. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 281-285.

The development of self-contained underwater breathing apparatus (SCUBA) in recent years has opened an entirely new world to those who are physically able to enjoy it. SCUBA is now used extensively in marine biology and is beginning to find its place in fresh water fisheries research ana management. More aquatic biologists would probably utilize SCUBA if they were more familiar with its possibilities and its limitations. It is the purpose of this paper to present information which will assist fisheries administrators and biologists in determining whether or not diving techniques could be used in their programs. (Authors)

9329. May, Otho D., Jr., and Jefferson C. Fuller, Jr. 1965. A STUDY ON STRIPED BASS EGG PRODUCTION IN THE CONGAREE AND WATEREE RIVERS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 285-301.

9330. Tatum, Walter M., and Robert D. Blackburn. 1965. PRELIMINARY STUDY OF THE EFFECTS OF DIQUAT ON THE NATURAL BOTTOM FAUNA AND PLANKTON IN TWO SUBTROPICAL PONDS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 301-306.

Two farm ponds in south Florida were treated with a concentration of 0.5 ppm by weight of 1,1'-ethylene-2,2'-dipyridylium dibromide (diquat) on April 4 and May 21, 1962, to determine the effect this aquatic herbicide may have on the bottom fauna and plankton naturally existing in these two bodies of water. Bottom samples were taken from the ponds with a 6" by 6" Ekman dredge before and after treatment. The organisms were sorted from the debris and counted. Plankton samples were also taken before and after treatment to evaluate the effect of this herbicide on the plankton. The results in pond number one indicated no change in the number of bottom organisms before and after treatment. However, chironomids failed to appear in the samples for the first 2 weeks after treatment. The second pond failed to show any reduction in numbers of this particular group of organisms. A large increase in the average number of organisms occurred after treatment in pond number two. Most of this increase in numbers came from the tremendous numbers of Chaoborus spp. Plankton samples before and after treatment in pond number one did not show any measurable difference. The volume of plankton per cubic meter in pond number two decreased the third day after treatment. However it increased during the next seven days to give a greater volume of plankton than before treatment. Water samples were taken from pond number two at periodic intervals after treatment to determine the persistence of diquat in the pond water. Duckweed (Lemna minor), being very sensitive to diquat, was used as an indicator plant. Diquat was present in the pond water at a concentration of 0.25 ppm by weight after three days, 0.01 ppm by weight after eleven days, and no detectable diquat sixteen days after treatment. (Authors)

9331. Nail, Merril L. (Fisheries Lab., Agric. Exper. Sta., Auburn Univ., Auburn, Ala.). 1965. THE PROTEIN REQUIREMENT OF CHANNEL CATFISH, Ictalurus punctatus (Rafinesque). Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 307-316.

A study was made to determine the level of dietary protein needed by channel catfish for optimum growth. The experimental work was conducted in the Farm

Ponds Laboratory of Auburn University, Auburn, Alabama. Each of 40 stainless steel troughs was stocked with 25 6- to 7-inch fish. These fish were fed experimental diets at a rate of 2.5 percent of their body weight per day. Every 14 to 21 days from June 22 to September 3, 1961, the fish were re-weighed and their daily amount of food adjusted to the new weight. Eight purified diets were fed, each to five randomly-assigned troughs. These diets contained protein levels of 6.3, 15.8, 25.3, and 34.8 percent at carbohydrate levels of 9.3 and 18.6 percent. Samples of fish were randomly selected at the beginning and at the end of the experiment for carcass analysis. Growth for each diet was compared along with the amount of protein deposited in an effort to determine the level of protein which produced optimum growth. Statistical analyses indicated that of the levels tested, a level of 25.3 percent protein produced optimum growth. Growth was obtained on the lowest level or 6.3 percent protein diet. The estimated maintenance requirement of protein for channel catfish in this experiment was 0.079 gram of protein per day per hundred grams of fish on the 9.3 percent carbohydrate diets and 0.029 gram of protein on the 18.6 percent carbohydrate diets. Based on these data, 0.23 gram of carbohydrate fed per hundred grams of fish would spare 0.05 gram of protein. (Auth.)

9332. Hughes, Janice S., and James T. Davis. 1965. COMPARATIVE TOXICITY TO BLUEGILL SUNFISH OF GRANULAR AND LIQUID HERBICIDES. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 319-323.

The toxicity to bluegill sunfish, Lepomis macrochirus, Rafinesque, of granular formulations of ten commercial herbicides is presented. The following chemicals are included: three esters of 2,4-dichlorophenoxyacetic acid; potassium salt of 2-(2,4,5-trichlorophenoxy) propionic acid; disodium salt of 3,6-endoxohexahydrophthalic acid; a mixture of the latter two materials; 2,3,6-trichlorophenylacetic acid; 2-methoxy-3,6-dichlorobenzoic acid; isopropyl n-(3-chlorophenyl) carbamate; and 2,6-dichlorobenzonitrile. The difference in the median tolerance limit of bluegill sunfish to liquid and granular formulations is discussed. Of the ten herbicides tested, most proved less toxic as granular formulations than as liquid formulations. The difference in toxicity as affected by granule size and type is also discussed. (Authors)

9333. Gould, W.R., III, and W.H. Irwin. 1965. THE SUITABILITIES AND RELATIVE RESISTANCES OF TWELVE SPECIES OF FISH AS BIOASSAY ANIMALS FOR OIL-REFINERY EFFLUENTS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 333-348.

9334. Conder, John R., and Ray Hoffarth. 1965. GROWTH OF CHANNEL CATFISH, Ictalurus punctatus, AND BLUE CATFISH, Ictalurus furcatus, IN THE KENTUCKY LAKE PORTION OF THE TENNESSEE RIVER IN TENNESSEE. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 348-354.

The age and rate of growth of channel and blue catfish were determined by the pectoral spine section aging technique. At the end of their first year's growth, channel catfish weighed 0.10 pound and were 4.3 inches in length (total length), and blue catfish weighed 0.12 pound and were 5.3 inches in length. At the end of ten years, channel catfish weighed 9.2 pounds and were 25.2 inches long, and blue catfish weighed 24.26 and were 33.3 inches long. (Authors)

9335. Hulsey, Andrew H. (Arkansas Game and Fish Comm., Joe Hogan State Fish Hatchery, Lonoke, Ark.). 1965. TRANSPORTATION OF CHANNEL CATFISH FRY IN PLASTIC BAGS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 354-356.

Channel catfish fry, ranging in age from one day old to about two weeks old, are routinely transported in polyethylene plastic bags with an oxygen atmosphere between fish hatcheries in Arkansas. Approximately 10,000 fry are transported per 18" X 32" bag in 1-1/2 gallons of well-oxygenated spring water of moderate hardness. These fish are transported by both airplanes and station wagons. (Auth.)

9336. Mathis, William P., Lee E. Brady, and William J. Gilbreath (Arkansas Game and Fish Comm., Little Rock, Ark.). 1965. PRELIMINARY REPORT ON THE USE OF POTASSIUM PERMANGANATE TO PRODUCE OXYGEN AND COUNTERACT HYDROGEN SULFIDE GAS IN FISH PONDS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 357-359.

Potassium permanganate is dissolved in fish hatchery ponds and minnow hatchery ponds at the rate of from 2 to 6 ppm to produce oxygen during acute oxygen shortage caused by excessive organic decay and to counteract hydrogen sulfide gas during seining operations. Potassium permanganate treatments are also used as prophylactic measures to prevent expected oxygen depletion. Empirical evidence indicates the efficaciousness of these treatments. A specially designated boat for the application of the chemical to the water was developed. (Authors)

9337. Thomaston, Willard W. (Georgia Game and Fish Comm., Atlanta, Ga.). 1965. THE RESULTS OF POPULATION ALTERATION AND FACTORS AFFECTING BALANCE IN FARM PONDS IN GEORGIA. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 361-370.

Methods and results of population investigation and alteration in Georgia farm ponds for approximately seven years is presented. Results of fishing pressure is also included. (Auth.)

9338. Wood, Roy K., and Donald E. Whelan. 1965. LOW-FLOW REGULATION AS A MEANS OF IMPROVING STREAM FISHING. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 375-386.

Studies by the U. S. Study Commission, Southeast River Basins, and cooperating agencies have disclosed that utilization of many streams in the study area is curtailed in part by excessively low stages and sometimes by excessively high stages during the fishing season. The U. S. Study Commission has considered the regulation of low flows by controlled discharge from upstream storage reservoirs as one means of improving such streams for fishing. Concepts and methods employed in the determination of flow-storage relationships, flow-fishery benefits are described in this paper. Results of the study indicate that the utility of some streams may be increased from two to five times with low-flow regulation; however, a much better understanding is needed of flow-storage-fishing relationships on which to base more accurate determinations of desired stages and potential benefits. (Authors)

9339. Hanson, Willis D. 1965. DYNAMICS OF THE LARGEMOUTH BASS POPULATION IN BULL SHOALS RESERVOIR, MISSOURI. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 398-404.

Black bass fishing in the White River Arm of Bull Shoals Reservoir, Missouri, was regarded as sensational for several years following its impoundment in 1952. In 1958, just after a tagging program was added to test netting and creel census programs, an unpredicted decline in black bass fishing began. Only largemouth bass nine inches or longer were tagged so population estimates include only that portion of the population. In 1958, black bass numbers reached an all-time high, but late that year the population began a decline which continued throughout the study. The average length of bass captured by electro-fishing increased each succeeding year, indicating a population of larger bass fewer in number. According to various measurements, 1958 began with a high predator population and a low forage population. Few schools of shad were seen, and largemouth bass scales showed poor growth. The percentage of yearlings each spring, a good indication of the success of the future fishery, was high in early 1958 but dropped sharply in 1959 and 1960. Low tag return rates indicated that angling did not seriously exploit the bass fishery. Information collected suggests the possibility of strong competition between white and black bass for forage. It suggests that white bass should not be stocked in new impoundments without careful consideration. (Auth.)

9340. Fry, James P. 1965. HARVEST OF FISH FROM TAILWATERS OF THREE LARGE IMPOUNDMENTS IN MISSOURI. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 405-411.

Quantitative creel census techniques were employed on Missouri tailwaters for the first time during 1961. Specific areas below Table Rock and Taneycomo Reservoirs on White River and below Clearwater Reservoir on Black River were censused using a stratified sampling technique throughout the year. Estimated fishing pressure on Table Rock tailwater was 608 hours per acre and the rate of catch amounted to 0.62 fish per hour. The yield per acre was about 380 fish, weighing 192 pounds. Hatchery reared rainbow trout comprised nearly 90 percent of the yield by number. Taneycomo tailwater supported an estimated 609 hours of fishing per acre. Rate of catch amounted to 0.55 fish per hour; the yield per acre was 343 fish weighing 408 pounds. White bass made up more than 37 percent of the total creel, followed by drum, crappie, channel catfish, and bluegill. Estimated fishing pressure on Clearwater tailwater was 1,607 hours per acre, with a catch rate of 0.55 per hour. The yield per acre was 930 fish weighing 845 pounds. Numerically, crappie comprised about 35 percent of the total catch, followed by carp, bluegill, channel catfish, and buffalo. Carp provided about one-third of the total weight. The tailwaters of Table Rock, Taneycomo and Clearwater reservoirs received 7, 10, and 16 times more fishing pressure per acre than the reservoirs themselves. Taneycomo tailwater had more fishermen than Lake Taneycomo. Taneycomo and Clearwater tailwaters provided greater total harvests by weight than did their respective reservoirs. (Auth.)

9341. Wyatt, Herbert N., and Howard D. Zeller. 1965. FISH POPULATION DYNAMICS FOLLOWING A SELECTIVE SHAD KILL. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 411-418.

Data is presented over a four-year period on population changes and dynamics in an 8,500-acre reservoir following rotenone treatment for selective shad reduction. Population data for four years prior to the shad kill is also discussed and analyzed. An analysis of the operation including methods, techniques, and results is presented. Records of fish stocking, creel census, age and growth and population studies after treatment is discussed and evaluated. Particular emphasis is directed toward two introduced species, white bass and threadfin shad. Data on the expansion and establishment of these introductions and the rapid growth rates encountered are presented. Year class dominance, reproduction, and fisherman success are compared, and the overall effect of selective shad kills on fish population changes is discussed and summarized. (Authors)

9342. Bowling, Michael L. 1965. THE EFFECTS OF LIME TREATMENT ON BENTHOS PRODUCTION IN GEORGIA FARM PONDS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 418-424.

Past research by the Georgia Game and Fish Commission on lime treatment of farm ponds has indicated a definite improvement in fertilization results following lime application. Management recommendations for problem areas has been one ton of agricultural lime per acre. This study was initiated to determine the effects of lime treatment on the qualitative and quantitative production of benthic organisms in upper coastal plain and piedmont ponds. Lime added at the rates indicated above will significantly increase production of benthic fish food organisms. This increase of bottom food organisms was accompanied by changes in soil and water pH and an increase in plankton production and total hardness of the water. In some instances it is believed that the addition of lime at the rate of one ton per acre is not sufficient to attain maximum benthos production. (Auth.)

9343. Surber, Eugene W. (U.S. Public Health Service, R.A. Taft Sanitary Eng. Center, Cincinnati, Ohio). 1965. WATER QUALITY CRITERIA FOR FRESH-WATER FISHES. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 435-436.

Good productivity of fish and aquatic life are dependent upon clear, clean water at favorable temperatures and with sufficient concentrations of needed

dissolved gases and solids. The number of individuals and species of bottom animals or plankton present in streams and lakes are important criteria of water quality. Siltation is one of the most damaging and widespread pollutants; it causes reduction of light penetration, destruction of shelter, and smothering effects on eggs. For short periods fishes tolerate turbidities up to 100,000 ppm, but under long-term exposure, concentrations of 100-200 ppm can be directly harmful. Fishes may tolerate dissolved solids up to 3,000 ppm or more if they are nontoxic earth metals and physiologically balanced. Bass and bluegill eggs and fry can survive in salt water up to about 10 percent sea strength. Temperatures of 93° to 96° F represent the critical level for most species of warmwater fishes. Trout require a maximum summer water temperature of about 68° F for good production. The effects of cooling waters from steam electric plants and towers of industrial plants may be detrimental to fish, imposing temperature blocks on spawning runs or reducing desirable food organisms. They may, however, provide places where anglers can harvest fishes or (in the south) places where threadfin shad, a desirable forage fish, can winter north of their normal range. Oxygen levels should be high enough to permit growth and reproduction. This level is about 5 ppm for warmwater fishes and 6 ppm for salmonid fishes. Oxygen requirements of fishes may be affected by the presence of carbon dioxide. The pH of streams of the United States generally ranges between pH 7.4 and 8.5. The acid death point for pond fishes is pH 4.0 and the alkaline death point pH 11.0. Levels of pH from 6.5 to 9.0 are most suitable for culturing pond fish. Organic wastes from domestic sewage and paper mills deplete oxygen supplies. Five-day BOD's above 10 ppm in streams and 3.5 ppm in lakes indicate pollutional effects. For bluegills, the toxic levels of some of the important industrial wastes are as follows: phenols, 48-hour median tolerance limit (TL_m), 22 ppm; cyanide, 96-hour TL_m, 0.15 ppm; copper, 30-day TL_m, 0.46 ppm in soft water—safe level, about 0.1 ppm; zinc, lethal level, 4 to 5 ppm as Zn^{++} in waters with pH's from 7.1 to 8.0 and hardnesses from 20 to 150 ppm—safe level, about 1 ppm; chromium, 96-hour TL_m, 110 ppm as dichromate, 170 ppm as chromate, 0.2 ppm as hexavalent chromium under conditions of continuous exposure; ammonia, 2.5 ppm, with toxicity dependent upon pH and extent of ionization. The 96-hour TL_m's of bluegills in soft water to some of the organic insecticides most widely used in the south are as follows: DDT, 0.016 ppm; BHC, 0.790 ppm; toxaphene, 0.0035 ppm; parathion, 0.700 ppm. (Auth.)

9344. Jones, R.O. (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1965. TOLERANCE OF THE FRY OF COMMON WARM-WATER FISHES TO SOME CHEMICALS EMPLOYED IN FISH CULTURE. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 436-445.

The toxicity of fifteen chemicals used in vegetation control or disease treatment was studied. The fry of largemouth black bass, Micropterus salmoides, bluegill, Lepomis macrochirus, and channel catfish, Ictalurus punctatus, were used as test animals. Chemicals included were three forms of silvex, three formulations of endothal, simazine, atrazine, diquat, two forms of benzenehexachloride, roccal, acriflavine, malachite green and methylene blue. Results of toxicity tests were used to arrive at a safe concentration of the various chemicals for the species of fry used as test animals. (Auth.)

9345. Allison, Ray (Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1965. THE EFFECTS OF FORMALIN AND OTHER PARASITICIDES UPON OXYGEN CONCENTRATIONS IN PONDS. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 446-449.

It is concluded that the use of formalin in ponds having a heavy plankton bloom may cause severe oxygen depletion. This is due to the increased B.O.D. resulting from the sudden death and decay of large amounts of plankton. At higher temperatures this process occurs more rapidly and may cause a more serious problem if ponds are treated for parasite control during the summer months. In the event that it becomes necessary to treat for parasite control during the summer months, the oxygen content can be restored in small ponds by sitrring with an outboard motor. In larger ponds, pumping is the most feasible means of aeration. The CO_2 content can be controlled through the addition of $Ca(OH)_2$. (Auth.)

9346. Rogers, Wilmer A. (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1965. A STUDY OF TWO STREAMS RECEIVING DOMESTIC SEWAGE. Proc. 16th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Oct. 14-17, 1962. pp. 449-463.

A study involving macro-invertebrate populations, fish populations, and water quality determinations was conducted on Bicycle Path Creek and Parkerson Mill Creek, Lee County, Alabama, during a nine-month period in 1959. The streams, averaging 7.0 and 5,8 inches in depth and 10.0 and 12.8 feet in width, respectively, received domestic sewage from approximately half of the 16,000 inhabitants of Auburn, Alabama. Sewage was diverted from Bicycle Path Creek and pumped via a lift station to a sewage treatment plant located on Parkerson Mill Creek. The plant became operative about halfway through the study and the treated effluent was discharged into Parkerson Mill Creek. Bottom organisms, which were collected at approximately two-week intervals from six stations on the two streams, were indicative of the polluted conditions, however, it was believed that not enough time had elapsed after the plant became operative for reinvasion by organisms used as indicators of unpolluted conditions. Organisms that could possibly have been classified as clean-water forms did not occur with any regularity or in significant numbers. Forms such as mayflies and stoneflies that are accepted indicators of clean waters were not found during this study. Fish populations were sampled on Parkerson Mill Creek three weeks before and approximately three months after the sewage treatment plant became operative. The first samples showed that no fish were present at the first two stations, 2.0 and 3.3 miles below the sewage outfall; and only six species were found at the last station, 4.3 miles downstream from the outfall. The latter samples showed fish to be present at all three stations below the outfall with thirteen species being present at the last station, apparently as a result of improved stream conditions. Water quality determinations clearly showed the polluted conditions of the streams and also the recovery following pollution abatement. (Auth.)

9347. Henderson, Harmon (A. E. Wood State Fish Hatchery, Parks and Wildlife Dept., San Marcos, Texas). 1965. OBSERVATION ON THE PROPAGATION OF FLATHEAD CATFISH IN THE SAN MARCOS STATE FISH HATCHERY, TEXAS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 173-177.

Although flathead catfish were very popular fish with the anglers of Texas, very little effort was made in the hatchery system to propagate these fish until about ten years ago. First, flatheads taken from lakes and rivers were used for brood fish. Repeated failures to get these fish to spawn, however, prompted hatchery personnel to rear offspring from some of the few spawns obtained from the feral fish so that hatchery-reared flatheads could be used for brood fish. This proved to be successful since eight pairs of hatchery-reared brood fish produced seven spawns the first year they were used and 11 spawns out of 12 pairs of these fish were obtained the next year. Hormone injections were not required to obtain these spawns. The hatchery-reared brood fish couldn't be sexed successfully until the fourth year, and no spawns were obtained until the fourth year, indicating this might be the time that sexual maturity is reached. Flatheads spawn during the month of May, at the San Marcos, Texas, hatchery. Water temperature is usually about 72 to 75 degrees Fahrenheit at this time of year. The pens and spawning jars used for channel catfish culture are used for spawning flatheads. Jars were checked every two days for spawns, and when a spawn was found, the jar wasn't checked again for six or seven days. After the eggs hatched, the jar was removed to a holding vat and left there until the yolk sacs of the fry were absorbed. The fry were then placed in one-half-acre rearing ponds. It was discovered that female brood fish should be removed immediately after spawning to keep them from being killed. The rearing ponds were fertilized with 50 percent protein meat and bone meal before introduction of the fry, to produce food for them. It was discovered that vegetation and crayfish should be eliminated from rearing ponds to obtain maximum recovery. The three types of fish used for forage were gambusia, fathead minnows, and goldfish. Ponds without crayfish produced as many as 2,865

fingerlings that measured from 3-1/2 to 4 inches in length and weighed 10 ounces to the hundred. Future plans call for an attempt to eliminate all crayfish from the rearing ponds and to again use gambusia, fathead minnows, and goldfish as forage. Artificial hatching of eggs will also be attempted. (Auth.)

9348. Giudice, John J. 1965. INVESTIGATIONS ON THE PROPAGATION AND SURVIVAL OF FLATHEAD CATFISH IN TROUGHS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 178-180.

An analysis of the mortality data indicates several pertinent observations. Two factors were responsible for 91 percent of the losses. The suspected thiamine deficiency undoubtedly contributed to the excessive loss following the formalin treatment for Scyphidia since symptoms associated with formalin toxicosis were not pronounced. Cannibalism was not considered a factor in the observed losses since no lacerations or teeth marks were noted on any of the moribund fish. No regurgitated or partially engulfed fish were seen. If fresh carp flesh is used in the diet it should be supplemented with beef liver. Any other fish flesh which contains the anti-thiamine factor should also be suspect.

9349. Snow, J.R. (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1965. RESULTS OF FURTHER EXPERIMENTS ON REARING LARGEMOUTH BASS FINGERLINGS UNDER CONTROLLED CONDITIONS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 191-203.

Experiments on rearing largemouth bass fingerlings to a size of 4-6 inches total length in rearing troughs and tanks are described. Fingerling fish 1.5-3.0 inches in length which had been started in earthern ponds on natural food were trained to take artificial food employing ground fresh or frozen fish as a starting diet. Following the initial training period the fish were fed a prepared ration composed of varying amounts of frozen fish or beef liver mixed with a dry trout food. Data on survival, growth, food conversion and special problems encountered are presented. The rate of growth appeared to be slower in the controlled environment than had been observed in ponds. A six to ten-fold increase in weight was measured in two different years for a feeding period of 73-120 days. Survival and food conversion was better in troughs (69 percent survival, conversion 2.6) than in concrete tanks (39 percent survival, conversion 3.3), but more than five times as many fish could be cared for with the same amount of labor in tanks than was possible in troughs. Also, the fish were more readily trained to take artificial food in tanks than in troughs. The author feels that the results obtained are promising enough to warrant further research on this method of bass culture. (Auth.)

9350. Hastings, W.H. 1965. PHYSICAL AND BIOCHEMICAL CHANGES IN FEEDS DURING PROCESSING. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 203-206.

Materials used for feeding fish may be subjected to drying, freezing, grinding, radiation, hard pelleting and expansion pelleting. During these processes, physical and chemical changes occur due to inherent enzymes, contamination by microorganisms, oxygen, temperature, pressure and ionization of molecules. These changes are not reflected in the gross composition of the major nutrient classes (protein, fat, carbohydrate, ash), but in the intrinsic nutrients, organic additives and digestibility. Experimental work showed the hard pelleting process to be destructive to added enzymes. (Auth.)

9351. Swingle, H.S., B.C. Gooch, and H.R. Rabanal (Agric. Exp. Sta. of Auburn Univ., Auburn, Ala.). 1965. PHOSPHATE FERTILIZATION OF PONDS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 213-218.

Pond fertilization with N-P-K has been used in the Southeast for the past 20 years to increase fish production and to control aquatic weeds and mosquitoes. In ponds which had been fertilized previously for a 15-year period with N-P-K, no significant decrease in production resulted from omitting both nitrogen and potassium from the fertilizer mixture during a four-year experimental period. It

appeared that adequate nitrogen for plankton production became available from nitrogen fixation by bacteria or algae and from the organic matter and ammonium stored in the bottom muds. Omission of phosphate, however, caused a decrease in production during all four years of the experiments. With no fertilization, production decreased during a two-year period; in the third and fourth years, production was approximately the same as in ponds that had never been fertilized. Phosphate fertilization only was tried in 14 ponds which had been fertilized for three to five years or more with N-P-K, and in which submersed pond weeds were absent. Satisfactory results were in general obtained in plankton production and in weed control. Eight ponds were subsequently drained and found to be supporting crops of fish at approximately the same levels as in previous years with 8-8-2 fertilization. However, in several ponds, response to fertilization was delayed for 30 to 60 days, which allowed growth of the branched filamentous alga Pithophora. Also in ponds where Microcystis scums were a problem with 8-8-2 fertilization, they continued to be a problem with phosphate fertilization. (Authors)

9352. Muncy, Robert J. (School of Forestry and Wildlife Management, Louisiana State Univ. Baton Rouge, La.). 1965. OBSERVATIONS ON THE FACTORS INVOLVED WITH FISH MORTALITY AS THE RESULT OF DINOFLAGELLATE "BLOOM" IN A FRESHWATER LAKE. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 218-222.

Complete fish mortality associated with the development of high populations of dinoflagellates (Gymnodinium spp.) was observed in 1960 in a 9.5 acre freshwater lake at Baton Rouge, Louisiana. Toxicity of the water samples containing the algae appeared to be related to the increased pH, length of exposure to sunlight and concentration of algal cells. Filtration with activated carbon removed the toxic effects. Laboratory tests offered data to explain the course of the fish mortality in the lake. (Auth.)

9353. Beasley, P.G. (Auburn Univ. Agric. Exp. Sta., Auburn, Ala.). 1965. THE PENETRATION OF LIGHT AND THE CONCENTRATION OF DISSOLVED OXYGEN IN FERTILIZED POND WATERS INFESTED WITH Microcystis. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 222-226.

Weekly measurements were made of light intensity, dissolved oxygen concentration, and water temperature at selected depths in five earthen experimental ponds. Measurements were made on a given pond on the same day between 7:00 a.m. and 8:45 a.m. and again between 10:00 a.m. and 11:45 a.m. The depth at which the average light intensity, as measured with submersible Weston Photronic photoelectric cells, was less than 1 percent incident radiation varied from 2.5 to 7.5 feet among the ponds, depending on the degree of Microcystis infestation. Generally, at depths where the average light intensity was not in excess of 1 percent incident radiation, the average dissolved oxygen concentration in the pond with the most dense growth of Microcystis was usually less than 1 ppm below 5 feet and less than 1 ppm below 7.5 feet in the ponds with the least amount of Microcystis. Generally, the decrease in water temperature with increased depth was directly related to the abundance of Microcystis. This study suggests that dense growths of scum-forming algae, such as Microcystis, limit the water depth at which the dissolved oxygen concentration is in excess of 1 ppm by limiting light penetration and by contributing to thermal stratification by heat absorption in the dense blooms near the water surface. (Auth.)

9354. Stevens, Robert E., Otho D. May, Jr., and Herschell J. Logan (South Carolina Wildlife Resources Dept., Columbia, S.C.). 1965. AN INTERIM REPORT ON THE USE OF HORMONES TO OVULATE STRIPED BASS (Roccus saxatilis). Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 226-237.

A total of 429 female striped bass were treated with hormones during the spring spawning seasons of 1962 and 1963. Of this number, 118 (26.6%) were induced to ovulate while held captive. One hundred of the ovulated fish were treated with

chorionic gonadotropin while used alone or in combination with other preparations. Eighteen of the ovulated fish were treated with follicle stimulating hormone while used alone or in combination with preparations other than chorionic gonadotropin. Fry production amounted to 2.6 million in 1962 and 13.8 million in 1963. All of the fry were stocked in the major reservoirs of South Carolina except the Santee-Cooper Reservoir. (Authors)

9355. Crittenden, Edward. 1965. FLORIDA PHOSPHATE PITS FOR MANAGED PUBLIC FISHING AREAS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 237-242.

Several mined-out and flooded phosphate pits near a large population center in peninsular Florida have been acquired and put under management by the Florida Game and Fresh Water Fish Commission for public sport-fishing purposes. Costs of making these abandoned phosphate areas accessible to the public are discussed; fishing pressure and sportfishing success on renovated ponds are reported and compared; and the relationships of size and shape of the ponds to success in fishery management are noted. (Auth.)

9356. Kirkland, Leon (Georgia Game and Fish Comm., Atlanta, Ga.). 1965. RESULTS OF A TAGGING STUDY ON THE SPOTTED BASS, Micropterus punctulatus. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 242-255.

One thousand seven hundred and forty-nine spotted bass were tagged in Allatoona Reservoir, Georgia, in the winter of 1961-62 and rewards were paid for return of the tags by sport fishermen. The nature of the spotted bass fishery and population density is described on the basis of these tag returns and creel census. Two hundred and sixty-two largemouth bass were tagged simultaneously and comparative data on the two species is given. (Auth.)

9357. Lambou, Victor W. (Louisiana Wild Life and Fisheries Comm., Baton Rouge, La.). 1965. THE COMMERCIAL AND SPORT FISHERIES OF THE ATCHAFALAYA BASIN FLOODWAY. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 256-281.

9358. Barkley, Harry and Barry Freeman. 1965. PRELIMINARY RESULTS IN THE USE OF A SPINE TAG. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 282-283.

A vinyl tube is being used on the dorsal spine of bass, crappie, and bluegill. Indications are that this tag does not have the adverse effect on the fish that the dart tag or the spaghetti tag has. Loss of tags at the present time is high but work continues using different diameters of tubing and the addition of a glue. (Authors)

9359. Davis, James T., and Janice S. Hughes. 1965. CREEL CENSUS ON BUSSEY BRAKE RESERVOIR FOR THE FIRST THREE YEARS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 284-290.

Bussey Brake Reservoir is a 2,200-acre impoundment located in northeast Louisiana near Bastrop, Louisiana. This lake was stocked by the Louisiana Wild Life and Fisheries Commission in 1959. It was opened to public fishing on April 30, 1960. Creel data collected through April 1963, are reported. Fishing pressure varied from 46,000 to 59,000 fisherman trips per year during this period. From 91 to 109 man-hours were spent per acre to catch 76 to 102 pounds of fish per acre. The success ratio varied from 1.74 to 2.29 fish per hour. The fish averaged 0.37 to 0.53 pounds. The average size of fish increased and the fishing success declined, but was high throughout the three-year period. With continued extensive usage of the lake, harvest rates of the same general magnitude should be possible for several years. (Authors)

9360. Strawn, Kirk (Dept. of Zoology, Univ. of Arkansas, Fayetteville, Ark.). 1965. RESISTANCE OF THREADFIN SHAD TO LOW TEMPERATURES. Proc.

17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 290-293.

Threadfin shad can be successfully maintained in aquaria for long periods on a diet of newly hatched brine shrimp. They quickly die at 5.0 and will survive the winter in a lake that does not go below 9.0 ° C. (Auth.)

9361. Bunting, Dewey L., and W.H. Irwin. 1965. THE RELATIVE RESISTANCES OF SEVENTEEN SPECIES OF FISH TO PETROLEUM REFINERY EFFLUENTS AND A COMPARISON OF SOME POSSIBLE METHODS OF RANKING RESISTANCES. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 293-307.

Eighteen species of fish including a reference species, were subjected to toxicity bioassay using petroleum refinery effluent as a toxicant. Twenty-four-hour and 96-hour median tolerance limits were calculated using a straight-line graphical interpolation based on ten specimens per concentration with a replication. Collection, laboratory, and bioassay histories were recorded for each test species and a general suitability statement made for each. Twenty-four-hour and 96-hour adjusted resistances obtained by the "Preadjusted-Abbreviated Doolittle" method were subjected to analysis of variance and to a modification of Duncan's new five percent multiple range test. Six methods were employed to adjust the relative resistance for differences in tests. The tests were ranked according to results obtained by each adjustment from most to least resistant. The "Interval" method was preferred over the other adjusted procedures on the bases of computational ease, ready addition of new data, compatible rankings with the "Preadjusted-Abbreviated Doolittle" method, and a lack of a "number effect". (Authors)

9362. Busbee, Raymond L. (Univ. of Georgia, Athens, Ga.). 1965. PRELIMINARY STUDIES ON THE EFFECT OF DYNAMITING FISH POPULATIONS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 326-338.

During 1963 a series of experiments was conducted to determine the effect of dynamite on fish populations. One set of these experiments consisted of placing various species of fish in cylindrical wire baskets which were suspended vertically in water ranging from 6 to 15 feet in depth. A dynamite charge, consisting of one stick of 60% ditching dynamite, was placed at a point 10 feet from the nearest line of baskets and detonated. Nine experiments were conducted using this arrangement of baskets in various depths of water with the dynamite charges ranging in depth from 2.5 feet below the surface to one foot from the bottom. The results of these experiments indicated the effective killing range of the dynamite charge and the most desirable depth at which to set the charge. From these tests it was found that some fish were killed up to a distance of 50 feet from the charge and that the greatest number of kills occurred when the charge was placed 2.5 feet below the surface. The second set of tests consisted of applying this technique in farm ponds. Three such ponds were dynamited, and the results are indicated. When rotenone was applied after dynamiting to remove the remainder of the fish population in Pond No. 1, it was observed that 38.7% of the total number of fish and 52.4% of the total weight of fish were eradicated with the dynamite technique. After rotenoning Pond No. 2, it was found that 84.2% of the total number and 73.3% of the total weight of the fish population were killed by the dynamite blast. In Pond No. 3, it was noted after rotenone was applied that the dynamite blast removed 55.7% of the total number of fish and 25.5% of the total weight. (Auth.)

9363. Rogers, W.A. (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1965. PRELIMINARY ATTEMPTS TO INCREASE MIDGES (TENDIPEDIDAE-DIPTERA) IN HATCHERY PONDS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 339-346.

In a food-habits study of young largemouth bass at the National Fish Hatchery, Marion, Alabama, midges were found to comprise 80 to 90 percent of the total food volume in fish from 25 to 55 millimeters in length. Since midges were found to be such an abundant food item in the diet of these fish, attempts were made to increase

the midge crop by providing additional surface area in the pond for attachment. It was found that ponds having a dominant blue-green algae bloom (Anacystis spp. and Anabaena spp.) produced more midges than ponds having a dominant green algae bloom (Oocystic spp., Chlorella spp., and Coelastrum spp.). Black polyethylene sheets, 1/8-inch masonite board, and 1/4-inch cement-asbestos board, plus concrete and clay-tile building blocks were oriented in different positions in a pond to determine which material and position were most productive. The masonite board proved to produce the most midges. Polyethylene sheet was next most productive. Of the three positions in which the sheet materials were tested; vertical (0°); horizontal (90°); and a 45° slant — the 45° position produced the most midges. Building blocks produced fewer midges than sheet materials and were more difficult to work with. (Auth.)

9364. Pierce, Phillip C., John E. Frey, and Henry M. Yawn (Georgia Game and Fish Comm., 401 State Capitol, Atlanta, Ga.). 1965. AN EVALUATION OF FISHERY MANAGEMENT TECHNIQUES UTILIZING WINTER DRAWDOWNS. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 347-363.

Data are presented on 15 small impoundments ranging from two acres to 500 acres in size where different fishery management techniques were utilized in conjunction with winter drawdowns. All ponds were lowered for approximately 80 days between October 1 and January 15. Nine small impoundments were lowered to approximately one-fourth their original sizes to evaluate the effect on fish populations crowded with intermediate bluegill. In each case heavy bass reproduction was observed the following spring. No significant improvement on bluegill growth was evident in five of these ponds even though the numbers of intermediate bream had been reduced. Bluegill reproduction the following summer was light and inadequate for good growth of the heavy bass reproduction produced as a result of the drawdown. Only the relatively infertile ponds or those containing high populations of intermediate bass prior to the drawdown produced definite improvements on bream growth and balance the following summer. Three small ponds heavily crowded with intermediate bluegill were lowered during the winter months and seined with a 60-foot, 1/2-inch mesh, bag seine. A definite improvement on bream growth and balance was found the following summer in one pond that contained a high population of intermediate-sized bass. Of the other two ponds where 153 and 80 pounds of intermediate bream per acre were removed, the former came into balance the following summer, but bream growth was only moderately improved. The latter pond did not come into balance nor did bream growth improve after 80 pounds of intermediate bream per acre had been removed. Both of these ponds were low in intermediate-sized bass which appears to be determinate in success for this type management. Fishing success was greatly improved in a 65-acre, fertilized impoundment following removal of 29 pounds per acre of adult golden shiners (Notemigonus crysoleucas) after winter drawdown. Prior to the drawdown and netting program, a one-acre rotenone sample using a block-off net produced 27 pounds of golden shiners per acre. In 90 netting days, using a one-inch mesh gill net (shirt-tail type), 8,148 shiners weighing 1,880 pounds were removed. A post-netting population study a year later in the same area produced only 2.1 pounds of adult shiners giving a 92.8% reduction. Less than 1% of the total poundage removed during the netting operation was comprised of fish other than golden shiners. Virtually, no shiner reproduction was found at the last population study. Predation by large fingerling bass and adult black crappie (Pomoxis nigromaculatus) populations was credited with the drastic removal of golden shiner reproduction. Two ponds, each two acres in size, were supplementally stocked with bass soon after they were lowered during a winter drawdown. One pond was stocked with 75 intermediate bass per acre and the other with 35 fingerling bass per acre. Bream growth had increased slightly in both ponds by fall; however, fishing success was not greatly improved. (Authors)

9365. Brown, Bradford E. (Auburn Univ., Agric. Exp. Sta., Auburn, Ala.). 1965. TWO-YEAR STUDY OF A BASS, SUNFISH, CHANNEL CATFISH POPULA-

TION EXPOSED TO FLOODING AND ANGLING. Proc. 17th Ann. Conf. Southeastern Assoc. Game and Fish Comm., Sept. 29-Oct. 2, 1963. pp. 347-363.

Results of this study point up four main conclusions with respect to a pond fish population. They are: (1) Trends in the dynamics of this fish population could be followed with periodic seining; (2) a stocking rate of 200 catfish per acre was too high to be used in a bass-bluegill-redear stocking combination, even though the number of sunfish was reduced to about 700 per acre; (3) that removal of a large number of predatory fish upset the balance, but that the population in time tended to balance itself since the loss of predatory fish was not great; and (4) rapid reduction in the proportion of harvestable fish in the population by angling led to an unbalanced condition.

9366. Hanson, Jack A., and Russell H. Wickwire (Calif. Dept. Fish and Game, Tahoe City, Calif.). 1967. FECUNDITY AND AGE AT MATURITY OF LAKE TROUT, Salvelinus namaycush (Walbaum), IN LAKE TAHOE. Calif. Fish and Game, 53(3): 154-164.

The relationship between fecundity and fork length in inches for 44 female Lake Tahoe lake trout was Y = -9,361.6 + 583.5X, and between fecundity and weight in grams, Y = 17.7 + 1.4X. The number of eggs produced ranged from 919 (17.9-inch fish to 11,472 (34.0-inch fish). There was considerable variation in the number of eggs among individual fish relative to both length and weight. A few fish matured in their 5th year of life, and all were mature in their 11th. Lake Tahoe lake trout appear to spawn every year. The spawning season lasts from the middle of September to the first half of November. Over 69% of the lake trout taken by anglers were immature. No changes in angling regulations were recommended. (Authors)

9367. Allen, George H., and Patrick O'Brien (Div. Natural Resources, Humboldt State College, Arcata, Calif.). 1967. PRELIMINARY EXPERIMENTS ON THE ACCLIMATIZATION OF JUVENILE KING SALMON, Oncorhynchus tshawytscha, TO SALINE WATER MIXED WITH SEWAGE POND EFFLUENT. Calif. Fish and Game, 53(3): 180-184.

The survival of king salmon in six experiments was tested in the following solutions: sea water from Humboldt Bay mixed with hatchery water, effluent from Arcata oxidation pond, and sea water from Humboldt Bay mixed with effluent. The experiments were carried out at hatchery facilities of Humboldt State College from February 2 through July 8, 1965. Six-week-old salmon showed tolerance to high salinities, but at 9 weeks of age tolerance of the fish decreased. After 9 weeks the salmon showed increasing tolerance to higher salinities with increasing age. Maximum survival occurred in mixtures of effluent and sea water. These mixtures also showed a therapeutic effect when the salmon were suffering mortalities from an unidentified internal parasite. Results indicated the desirability of field experiments to test the hypothesis that sewage effluent could be used to increase natural foods in saline ponds to rear salmon. (Authors)

9368. Mitchell, Charles T. (Calif. Dept. Fish and Game, Terminal Island, Calif.). 1967. AN INEXPENSIVE, SELF-CONTAINED UNDERWATER DATA RECORDING CAMERA. Calif. Fish and Game, 53(3): 203-208.

An inexpensive data recording camera with underwater housing designed for shallow water use is described. The unit requires no tending while in operation and will operate for long periods of time. (Auth.)

9369. Frantz, Ted C., and Almo J. Cordone (Nevada Fish and Game Comm., Reno, Nev.). 1967. FINAL INTRODUCTIONS OF THE BONNEVILLE CISCO (Prosopium gemmiferum Snyder) INTO LAKE TAHOE, CALIFORNIA AND NEVADA. Calif. Fish and Game, 53(3): 209-210.

The final introductions of Bonneville cisco into Lake Tahoe are described. Over a 3-year period 15,888 adults and 205,000 eggs were collected from Bear Lake, Utah-Idaho, and released in Lake Tahoe. (Authors)

9370. Fry, Donald H., Jr. (Calif. Dept. Fish and Game, Sacramento, Calif.). 1967. A 1955 RECORD OF PINK SALMON, Oncorhynchus gorbuscha, SPAWNING IN THE RUSSIAN RIVER. Calif. Fish and Game, 53(3): 211-216.

Pink salmon had been definitely recorded few times in California coastal streams, only once in the Russian River (in 1937). Prior to 1955 there had been occasional rumors of pinks in the Russian River, then in October 1955 on one riffle, two pinks were caught, four carcasses were found, and live spawners were seen on at least six redds. (Auth.)

9371. Bearden, Charles M. (Bears Bluff Laboratories, Wadmalaw Island, S. C.). 1967. SALT-WATER IMPOUNDMENDMENTS FOR GAME FISH IN SOUTH CAROLINA. Progressive Fish-Culturist, 29(3): 123-128.

The potentials of salt-water impoundments for raising estuarine game fish were examined, with particular emphasis on pond construction, stocking and managing, productivity, and suitable species. Ponds of the type discussed are particularly suited to the South Atlantic Coast of the U. S. Relatively inexpensive to construct, they usually involve simply diking off marshland sloughs which project into the highland. Management practices of major importance include dike upkeep, water control, and removal of undesirable species. The productivity of these ponds was relatively high, and a variety of forage organisms abounded. Game fish species which were most adaptable to pond conditions included red drum (Sciaenops ocellata), spot (Leiostomus xanthurus), black drum (Pogonias cromis), southern flounder (Paralichthys lethostigma), and several others. A major disadvantage of salt-water ponds at present is the dependency upon a natural supply of young fish for stocking purposes, but very satisfactory results can be obtained in spite of this handicap. (Auth.)

9372. Parisot, Thomas J. (Bur. of Sport Fisheries and Wildlife, Western Fish Disease Lab., Seattle, Wash.). 1967. A CLOSED RECIRCULATED SEA-WATER SYSTEM. Progressive Fish-Culturist, 29(3): 133-139.

A closed recirculated sea-water system has been in operation at the Western Fish Disease Laboratory, Seattle, Washington, for 18 months. The system was fabricated from plastic components, except for a marine plywood box which was coated with an epoxy resin varnish. During this period three full-capacity loads of water have been used: the first, changed after four months when it became fouled from excess feed; the second, changed after eight months when it showed indications of exhaustion; and the present supply, which has been in use for six months. For the past 14 months the system has been satisfactory for the maintenance of chinook salmon (Oncorhynchus tshawytscha) in a sea-water environment. (Auth.)

9373. Klein, W. D. (Dept. of Game, Fish and Parks, Ft. Collins, Colo.). 1967. EVALUATION OF A PULSATING DIRECT-CURRENT SHOCKING DEVICE FOR OBTAINING TROUT FROM A LAKE FOR POPULATION ESTIMATES. Progressive Fish-Culturist, 29(3): 140-149.

Attempts were made (1961-63) to obtain trout population estimates at Parvin Lake, Colorado, using a boat-mounted shocker to recover the fish for mark and recapture. The data were analyzed to determine the accuracy of the estimates and the bias associated with collecting trout with a shocker. An intensive creel census made during and after the population estimates provided a basis for the analysis. Population estimates derived from this use of a shocker were low, but an estimate based on fish collected by shocking, marked, released, and then recovered by fishing was probably high. One of four estimates showed a significant difference in the shocked fish recovery ratio for rainbow and hybrid trout (Salvelinus fontinalis x S. namaycush). Proportionately more small than large rainbow trout (Salmo gairdneri) were recovered with the shocker. Larger trout were recovered by fishing than with the shocker. The ratio of rainbow trout and hybrid trout recovered in May by fishermen approximated the ratio of these species in the lake, while the shocker recovered proportionately more hybrids. Mortalities among size groups recovered by shocking were not significantly different. Known mortality rates for hybrid and rainbow trout were the same. (Auth.)

9374. Beyerle, George B., and John E. Williams (Hastings Fisheries Research Station, Hastings, Mich.). 1967. ATTEMPTED CONTROL OF BLUEGILL REPRODUCTION IN LAKES BY THE APPLICATION OF COPPER SULFATE CRYSTALS TO SPAWNING NESTS. Progressive Fish-Culturist, 29(3): 150-155.

The shorelines of eight southern Michigan lakes were seined at specific locations in the fall of 1960 and 1961 to determine the relative abundance and size of young-of-the-year bluegills (Lepomis macrochirus). In 1962, all observed bluegill nests on four of these lakes were treated with copper sulfate crystals every 3 or 4 days throughout the bluegill spawning season in an attempt to kill all eggs and fry. In the fall of 1962, all eight lakes were seined and the results compared with pre-treatment data. The variability of the seining data was so great that no significant reduction in fingerling bluegill populations could be demonstrated for the treatments. In the treated lakes, more bluegills were collected in the fall of the treatment year than in the previous year. Even if the treatments had been successful, this technique required too much work for adoption as a management procedure. (Authors)

9375. Mathis, W. P. (Arkansas Game and Fish Comm., Lonoke, Ark.). 1967. A BOAT FOR STOCKING INACCESSIBLE WATERS. Progressive Fish-Culturist, 29(3): 155.

For better distribution of trout in inaccessible waters, an inexpensive alumium boat which could handle relatively large poundages of trout on short trips downstream was developed. (Auth.)

9376. Lockard, Dale V. (Nevada Fish and Game Dept., Ely, Nev.). 1967. ECONOMIC VALUE OF A SMALL RESERVOIR IN NEVADA. Progressive Fish-Culturist, 29(3): 156-159.

A 20-acre impoundment constructed in a semi-arid area of southeastern Nevada exclusively for recreational purposes is being developed as a trout fishery. During the first three years of impoundment the calculated total fishing pressure was 6,275 angler days. The total harvest during 1962 was 362 trout per surface acre, of which 72.3% had been stocked as catchable-sized fish. An expenditure study begun in the second year of impoundment showed that nearly one-third of the original cost investment was spent during the one year by people visiting the area strictly for recreational reasons. The calculated expenditure was $24,754, of which the resident county received 53.8%. The average expenditure per angler day was $5.60. The average total expenditure per day by all users was $162.70. Of this added income to the local economy, 74.2% ($9,890) was contributed by non-county residents. (Auth.)

9377. Thompson, Robert N., and John T. Heimer (Idaho Coop. Fishery Unit, Univ. of Idaho, Moscow, Idaho). 1967. A METHOD FOR DETERMINING DISSOLVED OXYGEN CONCENTRATIONS IN STREAM SUBSTRATES. Progressive Fish-Culturist, 29(3): 162-165.

A method of sampling stream substrates for the dissolved oxygen content of intragravel water is described. The apparatus consists of a short metal probe with a tapered steel plug and small in-take holes at one end and a section of latex tubing attached to the other end. Water is drawn into the apparatus by the pressure difference between the surface and the substrate. A pinch clamp applied to the latex tubing keeps water from entering the probe as it is inserted into the gravel. A medical syringe is used to withdraw water samples from the latex tubing without atmospheric contamination. A micro-Winkler method is used to determine the oxygen content of the samples. Techniques and limitations are discussed. (Authors)

9378. Jensen, Albert C., and Kenneth B. Cumming (Bur. of Commercial Fisheries Biological Lab., Woods Hole, Mass.). 1967. USE OF LEAD COMPOUNDS AND TETRACYCLINE TO MARK SCALES AND OTOLITHS OF MARINE FISHES. Progressive Fish-Culturist, 29(3): 166-167.

Lead acetate, lead versenate, and tetracycline were injected into Atlantic cod, Atlantic tomcod, summer flounder, and winter flounder to mark the scales and otoliths. The lead compounds formed no marks, but the tetracycline formed readily visible marks. (Authors)

9379. Spencer, Sam L. (Dept. of Conservation, Div. of Game and Fish, Montgomery, Ala.). 1967. INTERNAL INJURIES OF LARGEMOUTH BASS AND BLUEGILLS CAUSED BY ELECTRICITY. Progressive Fish-Culturist, 29(3): 168-169.

To determine the extent of internal injury, 1,575 bluegills (Lepomis macrochirus) and 70 largemouth bass (Micropterus salmoides) were dissected after shocking with 230 v. A. C. (3-phase), 115 v. A. C. (single phase), and 115 v. D. C. Only one of the bass had a visible injury. In the bluegills, 230 v. A. C. resulted in 12.2% vertebral injury, 115 v. A. C. resulted in 4.6% vertebral injury, and 115 v. D. C. in 1.5% vertebral injury. There was no relation between length of exposure time to the electrical stimulus and percentage incidence of injured vertebrae. Most ruptures occurred between the second and eighth caudal vertebrae. (Auth.)

9380. Fujihara, M. P., and R. E. Nakatani (Batelle Memorial Inst., Pacific Northwest Lab., Richland, Wash.). 1967. COLD AND MILD HEAT MARKING OF FISH. Progressive Fish-Culturist, 29(3): 172-174.

A technique for marking fish with instruments cooled to -80° C by immersion in ethanol dry-ice slurry is described. The instruments froze on the skin, preventing slippage, and facilitated rapid marking. Marks by the cold method were legible at four months. For short-term studies, cold and mild heat (100° C) methods were equally effective. (Authors)

9381. Everest, Fred H., and Eldon H. Edmundson (Idaho Coop. Fishery Unit., Univ. of Idaho, Moscow, Idaho). 1967. COLD BRANDING FOR FIELD USE IN MARKING JUVENILE SALMONIDS. Progressive Fish-Culturist, 29(3): 175-176.

The cold-brand technique described is easily applied in the field and satisfactory for marking small fish when individual identification is required in the field for short-term behavioral studies.

9382. Vogele, Louis E., and William R. Heard (Bur. of Sport Fisheries and Wildlife, Fayetteville, Ark.). 1967. AN EXPERIMENTAL HATCHING AND REARING FACILITY FOR LARVAL RESERVOIR FISHES. Progressive Fish-Culturist, 29(3): 177-179.

Barge-housed hatching and rearing facilities using reservoir water were developed to obtain larval series of reservoir fishes. Plywood tanks and collecting aquaria, plastic hatching jars, and an electrically powered centrifugal water pump were the main components of the hatchery. Two 600-gallon plastic wading pools and 8 glass aquaria of 5- to 50-gallon capacity were used as rearing facilities. Eggs of stoneroller (Campostoma anomalum), logperch (Percina caprodes), highfin carpsucker (Carpiodes velifer), golden redhorse (Moxostoma erythrurum), and river redhorse (M. carinatum) were artificially fertilized, and the larvae successfully reared in the hatchery. (Authors)

9383. Johnson, William C. (Fed. Water Pollut. Control Admin., Klamath Basin Study, Klamath Falls, Oreg.). 1967. A POWER PLANKTON PUMP WITH A METERING DEVICE. Progressive Fish-Culturist, 29(3): 182-183.

A pumping system consisting of a 4,200-gallon-per-hour pump, a 25-gallon expansion chamber with a 295-micron mesh plankton net, and a household water meter was developed to collect quantitative plankton samples for pesticide analysis. Plankton are collected in the expansion chamber and do not pass through the pump impeller or water meter. (Auth.)

9384. Margolis, L., F. C. Cleaver, Y. Fukuda, and H. Godfrey (Fish. Res. Bd. of Canada Biol. Sta., Nanaimo, B. C., Canada). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART VI. SOCKEYE SALMON IN OFFSHORE WATERS. International North Pacific Fisheries Comm., Bull. No. 20. 70 p.

9385. Anonymous. 1967. 1966 RESEARCH IN FISHERIES. College of Fisheries, Fish. Res. Inst., Univ. of Washington Contribution No. 240. 72 p.

9386. Legler, Donald W., E. Edward Evans, and Harry K. Dupree (Univ. of Alabama Medical Center, Birmingham, Ala.). 1967. COMPARATIVE IMMUNOLOGY: SERUM COMPLEMENT OF FRESHWATER FISHES. Trans. American Fisheries Soc., 96(3): 237-242.

Channel catfish, bigmouth buffalo, goldfish, longnose gar, bowfin, paddlefish, and sturgeon were investigated for the presence of hemolytic complement using several heterologous erythrocyte systems. All species exhibited hemolytic activities similar to a guinea pig complement-rabbit antibody system in their reactions to heat, EDTA, hydrazine, and carrageenin. Pooled complement titers ranged from 9.2-49.0 C'H50 units. Reference lamprey serum was hemolytically inactive. Sephadex fractionation of longnose gar serum showed hemolytic components present in both 19 S and 8 S protein peaks. Results suggested that complement systems in these species resembled mammalian complement. No marked differences in complement-forming ability were observed between these species of fish in relation to their phylogenetic position. (Authors)

9387. Miller, Robert Victor. 1967. FOOD OF THE THREADFIN SHAD, Dorosoma petenense, IN LAKE CHICOT, ARKANSAS. Trans. American Fisheries Soc., 96(3): 243-246.

Forty-nine threadfin shad (36-119 mm SL) were collected in Lake Chicot, Arkansas, from February 27 to November 7, 1959. They appeared to feed on any available organism of suitable size. Organisms eaten represented more than 60 genera. Animal and plant foods were present in approximately equal amounts; protozoans and invertebrate eggs composed most of the animal food, and green algae (Chlorophyta) most of the plant food. Individual threadfin shad within a sample ate the same kinds of organisms in similar proportions. Correlations between ingested organisms and those in the plankton were significant, indicating a lack of food selectivity. There was no apparent difference in the food of fish of different sizes. (Auth.)

9388. Fuchs, Everett H. (North Central Reservoir Investigations, Bur. of Sport Fisheries and Wildlife, Yankton, S. D.). 1967. LIFE HISTORY OF THE EMERALD SHINER, Notropis atherinoides, IN LEWIS AND CLARK LAKE, SOUTH DAKOTA. Trans. American Fisheries Soc., 96(3): 247-256.

The age, rate of growth, reproduction, feeding habits, and population dynamics of the emerald shiner (Notropis atherinoides) were studied from 10,375 fish collected in Lewis and Clark Lake, South Dakota. The population in this 28,000-acre reservoir consisted of four age groups dominated by young-of-the-year during the summer and fall and by age-group I during the spring and early summer. Age-group II was common only in the spring and early summer while age-group III was rarely encountered. Average lengths at first and second annulus formations were 66 and 84 mm. Females attained larger sizes than males after the first year. The spawning season extended from June through August. A rapid and precise method was devised for conducting food-habit determinations that could be analyzed statistically. Adult emerald shiners fed selectively on large zooplankton. A gradual change in young-of-the-year food habits was evident; fish smaller than 40 mm fed primarily on algae, whereas larger fish fed chiefly on cladocerans and copepods. Populations of emerald shiners were characterized by high mortality that caused drastic changes in age-class structure. Males had a higher mortality rate than females during their second and third years of life. (Auth.)

9389. Alexander, Gaylord R., and David S. Shetter (Michigan Dept. of Conservation, Lewiston, Mich.). 1967. FISHING AND BOATING ON PORTIONS OF THE AU SABLE RIVER IN MICHIGAN, 1960-63. Trans. American Fisheries Soc., 96(3): 257-267.

Fishing and boating activity on 50.2 miles of the Au Sable River in Crawford and Otsego Counties, Michigan, was measured by stratified random sampling during 1960-63. On the main stream and South Branch of the Au Sable, man-hours of canoeing far exceeded fishing activity, whereas fishing constituted all but a minor fraction of the recreational activity on the North Branch. Observations

during the daily period 8 AM-11 PM between the last Saturday in April and the second Sunday in September (regular trout season) led to the following estimates of average total hours of recreation (canoeing plus fishing) per season: Main Au Sable River—11,325 hours per mile per season, South Branch—3,354 hours per mile per season, North Branch—1,729 hours per mile per season. On the Main Au Sable, 32% of the recreational use was angling; on the South Branch, 44%; on the North Branch, 99.7%. On all three streams, 25 to 40% of the season's fishing was done between Decoration Day and July 4. On the Main Au Sable most boating was done during the third and fourth quarters of the trout season. The first quarter was preferred by the South Branch canoeists. Simultaneous use by anglers and canoeists on the Main Stream and South Branch is an important source of conflict. On the North Branch, where little boating is done, angler activity is fairly uniform during the day. On the Main Au Sable and South Branch, angler use increased sharply after 6 PM when boater use was light. Anglers and boaters from the metropolitan areas of southeastern Michigan constituted a significant fraction of the drainage users; 10% were from other states. Thirty-nine percent of the boaters were under age 17, but only three to seven percent of the anglers were under 17. Angling results on the test waters were listed and were discussed briefly. (Authors)

9390. Rahrer, Jerold F. (Bur. of Commercial Fisheries, Ashland, Wisc.). 1967. GROWTH OF LAKE TROUT IN LAKE SUPERIOR BEFORE THE MAXIMUM ABUNDANCE OF SEA LAMPREYS. Trans. American Fisheries Soc., 96(3): 268-277.

The growth in length of lake trout (Salvelinus namaycush) from the inshore water of Lake Superior in 1953 increased with age from the 3rd to 9th year, and was nearly constant from the 9th to the 12th year. Growth was greatest in the 1st year (4.0 inches) and least in the 2nd and 3rd years (2.3 inches). Between the 4th and 9th years the increments increased from 2.6 to 3.5 inches. Growth was calculated from a curvilinear body-scale relation. Intraseasonal growth in length extended from late April until well after October; most growth was in late summer and fall. The younger fish started growth earlier and some mature fish did not increase in length until after the October spawning. Lake trout reached the minimum legal weight (1.5 pounds) in the 7th year of life and the average size taken in the commercial fishery (about 3 pounds) in the 8th year. The annual increase in weight in the 8th year of life was over 64%. Fish used in this study grew more slowly than those from Lakes Michigan and Huron taken during the period when sea lamprey abundance was increasing, but at about the same rate as lake trout of Lake Michigan before the sea lamprey appeared. (Auth.)

9391. Colby, Peter J., and Lloyd L. Smith, Jr. (Dept. of Entomology, Fisheries and Wildlife, Univ. of Minnesota, St. Paul, Minn.). 1967. SURVIVAL OF WALLEYE EGGS AND FRY ON PAPER FIBER SLUDGE DEPOSITS IN RAINY RIVER, MINNESOTA. Trans. American Fisheries Soc., 96(3): 278-296.

Investigations of paper-fiber sludge deposits in the Rainy River, Minnesota, below paper mills were made to determine water characteristics over them with reference to survival of walleye (Stizostedion v. vitreum) eggs and fry and occurrence of bottom fish-food organisms. Sampling of water from the fiber-sludge water interface to the surface showed gradients in oxygen as great as 0.1 ppm to near saturation, and in dissolved sulfides from 0.8 to 0.0 ppm. The most rapid gradient of these materials was in the bottom 20 mm. Levels of sulfides were most affected by current velocity and showed little relation to temperature or season. Walleye eggs placed in test trays on fiber mats had lower survival than those placed 12 inches above the mats and those placed on mineral substrates. Eggs and fry placed on mats died within 48 hours. Laboratory bioassays showed that sulfide levels of 0.3 ppm under controlled conditions approximating river conditions were acutely lethal to Gammarus pseudolimnaeus and walleye eggs and fry. Fiber released from paper mills forms sludge mats as far as 62 miles below outfalls and creates oxygen deficiencies and H_2S concentrations near the sludge-water interface that are lethal to early life history stages of fish and some fish-food organisms. (Authors)

9392. Goodyear, C. Phillip. 1967. FEEDING HABITS OF THREE SPECIES OF GARS, Lepisosteus, ALONG THE MISSISSIPPI GULF COAST. Trans. American Fisheries Soc., 96(3): 297-300.

During the summer of 1965, stomach contents of three species of gars from brackish water of the Mississippi Coast were examined. An attempt was made to correlate the types and amounts of food items eaten with ecological conditions which prevailed at the time of the capture. The alligator gar, Lepisosteus spatula, fed heavily on sea catfish and other fishes which were periodically discarded around docks and piers as refuse. The longnose gar, L. osseus, which fed primarily on largescale menhaden atnight, was a more active predator. In contrast, L. oculatus, the spotted gar, was found to prey extensively on fiddler crabs and small blue crabs in the shallows during rising and high tides. (Auth.)

9393. Gakstatter, Jack H., and Charles M. Weiss (Dept. of Environ. Sciences and Engineering, Univ. of North Carolina, Chapel Hill, N. C.). 1967. THE ELIMINATION OF DDT-C^{14}, DIELDRIN-C^{14}, AND LINDANE-C^{14} FROM FISH FOLLOWING A SINGLE SUBLETHAL EXPOSURE IN AQUARIA. Trans. American Fisheries Soc., 96(3): 301-307.

Groups of 60 to 70 small bluegills, Lepomis macrochirus, and goldfish, Carassius auratus, were exposed in polyethylene tanks to 0.03 ppm of DDT-C^{14}, dieldrin-C^{14}, or lindane-C^{14} for periods ranging from 5 to 19 hours. Following the exposure, these fish were rinsed with uncontaminated water and placed in 145-liter recovery aquaria. The water in these aquaria was continuously renewed at the rate of 2.5 complete changes daily. An equivalent number of unexposed fish were also placed in the recovery aquaria to serve as controls. During a recovery period of 32 days, 10 samples, each consisting of five exposed and five control fish, were removed from each aquarium for determinations of whole-body insecticide content. The results indicated that the initial lindane-C^{14} was eliminated by both species of exposed fish within two days. More than 90% of the initial dieldrin-C^{14} was eliminated in the first two weeks of recovery, however, less than 50% of the DDT-C^{14} was eliminated after 32 days of recovery. These studies also showed that labeled DDT and dieldrin were readily transferred from contaminated fish to uncontaminated controls in the recovery aquaria. (Authors)

9394. Chapman, D. W., H. J. Campbell, and J. D. Fortune, Jr. (Idaho Coop. Fishery Unit., Univ. of Idaho, Moscow, Idaho). 1967. SUMMER DISTRIBUTION AND FOOD OF KOKANEE AND TROUT IN ELK LAKE, OREGON. Trans. American Fisheries Soc., 96(3): 308-312.

Samples of kokanee, brook trout, and rainbow trout in Elk Lake, Oregon, were taken with gill nets and a mid-water trawl in the summers of 1962 and 1963. Brook trout were associated closely with the lake bottom. Small fish were most abundant in shallow waters, larger ones tended to be in deep water. Kokanee were found in all depths except in mid-summer when they were largely associated with the bottom. Throughout the summer, kokanee and brook trout generally used different foods while rainbow and brook trout may have extensively used foods in common. There was evidence that higher fishing mortalities occurred among kokanee than brook trout. (Authors)

9395. Mason, John W., Oscar M. Brynildson, and Paul E. Degurse (Wisconsin Conservation Dept., Madison, Wisc.). 1967. COMPARATIVE SURVIVAL OF WILD AND DOMESTIC STRAINS OF BROOK TROUT IN STREAMS. Trans. American Fisheries Soc., 96(3): 313-319.

Survival and growth of progeny of domestic, domestic X wild, and wild strains of brook trout (Salvelinus fontinalis) were compared after these trout were released during the fall as fingerlings 9 to 10 months old in selected sections of streams. One group of the wild strain was hatched and reared in the wild. Other groups were hatched and reared in the hatchery. The domestic strain had the highest over-winter survival in three of five streams. In only one stream did the wild strain have the highest over-winter survival. Survival of the domestic and domestic X wild strains through the summer fishing season was generally too low

to evaluate survival of these strains through the second winter. The domestic strain grew most rapidly in the hatchery followed by the domestic X wild strain. This growth advantage was not maintained after release into streams. Brook trout of the domestic strain were harvested early in the fishing season and did not contribute to the late-season catch, whereas the domestic X wild and wild strains were harvested throughout the fishing season. (Authors)

9396. Herr, F., E. Greselin, and C. Chappel (Ayerst Research Laboratories, Montreal, Canada). 1967. TOXICOLOGY STUDIES OF ANTIMYCIN, A FISH ERADICANT. Trans. American Fisheries Soc., 96(3): 320-326.

Antimycin (Fintrol^{R}) is used as an eradicant for coarse fish. Its usefulness for this purpose is based on its extremely high immersion toxicity for fish. Observations made of the acute toxicity of Antimycin for goldfish by immersion, intraperitoneal or oral injection suggest an effect on respiration at the gills. Acute and chronic toxicity studies indicate that Antimycin has relatively low toxicity for mammals which is another prerequisite of its usefulness as a fishery tool. There is a moderate irritation potential if the compound is applied repeatedly in high concentration to the skin or eye of rabbits. The degradation products of Antimycin were found to be devoid of toxicity. In view of the high specificity of this agent for fish, the rapidity with which it breaks down and the safety of the degradation products, Antimycin would appear to have marked advantages over fish eradicants currently in use. (Authors)

9397. Chadwick, Harold K. (Inland Fisheries Branch, California Dept. of Fish and Game, Stockton, Calif.). 1967. RECENT MIGRATIONS OF THE SACRAMENTO-SAN JOAQUIN RIVER STRIPED BASS POPULATION. Trans. American Fisheries Soc., 96(3): 327-342.

Migration patterns of striped bass (Roccus saxatilis) in the Sacramento-San Joaquin River system, California, are defined by tag returns from 18,300 tagged fish and angler catches from 1958 through 1964. Larger adults migrated farther downstream than smaller ones, and most 3- and 4-year-old immature fish remain in the Bay Area during the spawning period. Fish tagged in the western and eastern Delta during the spring, in the western Delta during the fall, in the upper Sacramento River during the spring, and in San Pablo Bay during the fall all had similar migration patterns. The only general difference was each group had a distinctive migration to the Delta. Migrations into San Francisco Bay and the Pacific Ocean were much greater in the late 1950's and early 1960's than in the early 1950's. Data on changes in the striped bass population and environment were insufficient to explain migration changes. Earlier conclusions regarding factors controlling seaward migration did not adequately explain migration variations between 1958 and 1964. (Auth.)

9398. Richards, C. E. (Virginia Inst. of Marine Science, Gloucester Point, Va.). 1967. AGE, GROWTH AND FECUNDITY OF THE COBIA, Rachycentron canadum, FROM CHESAPEAKE BAY AND ADJACENT MID-ATLANTIC WATERS. Trans. American Fisheries Soc., 96(3): 343-350.

Age, growth, fecundity, and distribution of cobia, Rachycentron canadum, were studied. Data were collected primarily from lower Chesapeake Bay and adjacent mid-Atlantic waters. Age analysis by scale methods, growth estimates by use of Bertalannfy's equation, and observations of juvenile cobia indicate rapid growth. Ten age groups represented in scale collections from 284 fish, 4.2-56.4 inches in fork length. Males and females can mature at two and three years, respectively. Growth equations are: males, $L_t = 49(1-e^{-21(t+0.67)})$, $W_t = 59 \times (1-e^{-0.13(t-0.62)})$; females, $L_t = 59(1-e^{-0.20(t+0.65)})$, $W_t = 120(1-e^{-0.10(t-0.80)})$. Fecundity in hundreds of thousands of eggs was evaluated as a function of body weight where fecundity was equal to 0.98 times the weight in pounds minus 6.39. The spawning season, late June through mid-August, was defined through observation of gonadal tissue. A disproportionate sex ratio for areas within Chesapeake Bay was noted, 74:26 and 28:72 males to females, for eastern and western shore areas respectively. A possible relation between spawning and a high ratio of males to females was noted for eastern shore areas. (Auth.)

9399. Welker, Bill (30th and Grandview, Apt. 23, Sioux City, Iowa). 1967. MOVEMENTS OF MARKED CHANNEL CATFISH IN THE LITTLE SIOUX RIVER, IOWA. Trans. American Fisheries Soc., 96(3): 351-353.

9400. Brynildson, Oscar, and Clifford L. Brynildson (Wisconsin Conservation Dept., Madison, Wisc.). 1967. THE EFFECT OF PECTORAL AND VENTRAL FIN REMOVAL ON SURVIVAL AND GROWTH OF WILD BROWN TROUT IN A WISCONSIN STREAM. Trans. American Fisheries Soc., 96(3): 353-355.

9401. Boyar, H. C., and R. A. Clifford (Bur. of Commercial Fisheries Biological Lab., W. Boothbay Harbor, Maine). 1967. AN AUTOMATIC DEVICE FOR COUNTING DRY FISH EGGS. Trans. American Fisheries Soc., 96(3): 361-363.

9402. Irwin, William H., James M. Symons, and Gordon G. Robeck. 1966. IMPOUNDMENT DESTRATIFICATION BY MECHANICAL PUMPING. Jour. of the Sanitary Engineering Division, ASCE, Vol. 92, No. SA6, Proc. Paper 5032. pp. 21-40.

Mechanical pumping was used to break up thermal stratification in four lakes in southern Ohio during the summer of 1964. The lake volumes were 98, 100, 120, and 1,260 acre-ft. Each impoundment was thermally and chemically stratified before pumping began. The equipment was a pontoon-mounted, axial-flow pump, 13 acre-ft. per day capacity, driven by a gasoline engine. The pump drew water from the bottom and discharged it at the surface. Profiles of temperature, pH, and concentrations of dissolved oxygen and carbon dioxide were taken before and after pumping. Data presented show that this method was effective in destratifying these lakes. In addition, the data show that water quality was improved by artificial destratification and that an entire impoundment could be mixed with the pump located at a single position. Some data are presented on total work requirements, but these were found to be dependent on the efficiency of the mechanical equipment and the percentage of cold water in the impoundment before pumping. (Authors)

9403. Boyle, H. W., R. H. Burttschell, and A. A. Rosen. 1966. INFRARED IDENTIFICATION OF CHLORINATED INSECTICIDES IN TISSUES OF POISONED FISH. In: Organic Pesticides in the Environment, Advances in Chemistry Series, Number 60. pp. 207-218.

A method for identifying chlorinated insecticide residues in fish tissue is described. Whereas electron capture gas chromatography guides the isolation procedures and provides tentative identification and quantitative estimation, positive identification is made on the basis of the infrared spectrum of isolated insecticides. The procedure consists of hexane extraction of fish tissue, partition between hexane and acetonitrile, column adsorption and thin layer chromatography cleanup, and micro-infrared analysis in a potassium bromide disc. The practical limit of sensitivity needed to provide excellent infrared spectra of a number of the more common chlorinated insecticides is about 1 ppm in the fish tissue; concentrations as low as 0.25 ppm have given informative infrared spectra. (Authors)

9404. Williams, A. K., and Carl R. Sova (Southeast Water Lab., Dept. of the Interior, Athens, Ga.). 1966. ACETYLCHOLINESTERASE LEVELS IN BRAINS OF FISHES FROM POLLUTED WATERS. Bull. Environmental Contamination and Toxicology, 1(5): 198-204.

Distressed menhaden collected from the Ashley River, South Carolina, were found to have 46.8% less acetylcholinesterase (AChE) activity in brain homogenates as compared to menhaden collected from offshore waters. Menhaden and croakers also taken from the Ashley River, but not in a distressed condition, were found to be 16.5 and 35.8% inhibited, respectively. AChE inhibiting materials were found in three of twelve waste water samples collected from the vicinity of the Ashley River. (Auth. summ.)

9405. Ditsworth, George R. (Pacific Northwest Water Lab., Corvallis, Oreg.). 1966. ENVIRONMENTAL FACTORS IN COASTAL AND ESTUARINE WATERS,

BIBLIOGRAPHIC SERIES — VOLUME I, COAST OF OREGON. Federal Water Pollution Control Administration, Water Pollution Control Research Series, Publication WP-20-2. 62 p.

Indexed herein are references to literature pertaining to the marine waters of Oregon. References to papers, depending on the subject matter contained in the paper, are indexed under one or more of the following headings: Marine Biology, Climate, Fisheries, Geology, Hydrology, Chemical and Physical Oceanography, and Bibliographies, Literature Surveys and Compilations. (Auth.)

9406. Nyman, Lennart (Inst. of Genetics, Univ. of Uppsala, Uppsala, Sweden). 1967. PROTEIN VARIATIONS IN SALMONIDAE. Inst. of Freshwater Research, Drottningholm, Report No. 47. pp. 5-38.

By means of a starch gel electrophoresis method water soluble proteins and enzymes were investigated in 11 species and 4 hybrid "species" of fish belonging to the family Salmonidae. Examples of species specificity, ontogenetic variation, geographic variation and various polymorphisms are presented and discussed, together with problems concerning the segregation of proteins in hybrids.

9407. Norlin, Ake (Entomological Dept., Inst. of Zoology, Uppsala, Sweden). 1967. TERRESTRIAL INSECTS IN LAKE SURFACES. THEIR AVAILABILITY AND IMPORTANCE AS FISH FOOD. Inst. of Freshwater Research, Drottningholm, Report No. 47. pp. 39-55.

The occurrence of terrestrial insects in the water surface, the drifting fauna, has been examined in a number of lakes in the high mountain regions of Sweden and Switzerland. The supply of these insects seems to depend in the first place upon the production of insects in the immediate neighborhood of the lakes and upon the capacity of the region to create transporting air currents. In 75 percent of the samples the biomass falls short of 3.0 mg/m^2, while the median samples, both from the individual lakes and the total material, deviate little from 1.0 mg/m^2. The biomass, which is small, for example in comparison with the bottom fauna, is by way of compensation easily available as prey. This explains the high degree of utilization of the drifting fauna as fish food. The importance of this type of allochthonous contribution in regulated lakes is accentuated by the fact that, contrary to many other comparable fish food organisms, it is little influenced by the interference resulting from regulation of the water level.

9408. Wendt, Curt (Salmon Res. Lab., Alvkarleo, and Inst. of Zoophysiology, Univ. of Gothenburg, Gothenburg, Sweden). 1967. MORTALITY IN HATCHERY-REARED Salmo salar L. AFTER EXERCISE. Inst. of Freshwater Research, Drottningholm, Report No. 47. pp. 98-112.

In August 1964, 42 percent of a pellet-fed group of hatchery-reared salmon were moribund when sampled 115-360 minutes after exercise. In August 1965, 31 percent of a group fed on a raw diet were moribund when sampled as the gill movements ceased after 60-300 minutes. Mortality rate seemed to be closely related to the blood lactate level. The critical threshold for blood lactate in 1-1/2-year-old hatchery-reared salmon is considered to be about 200 mg percent. The exercise caused a decrease in muscle glycogen varying between 52 and 67 percent. There was no significant decrease in liver glycogen immediately after exercise, but after 2 hours of recovery the loss ranged between 49 and 71 percent. The moribund fishes also showed low liver glycogen levels. (Auth. summ.)

9409. Nilsson, Nils-Arvid, and Gote Andersson. 1967. FOOD AND GROWTH OF AN ALLOPATRIC BROWN TROUT IN NORTHERN SWEDEN. Inst. of Freshwater Research, Drottningholm, Report No. 47. pp. 118-127.

The food, growth, length-weight relationship and flesh coloration of brown trout in Lake Sippmikken, northern Sweden, were investigated. The fish were found to feed to a great extent on small Crustacea after impoundment, and the first-, second- and third-year growth had improved. The enhanced growth after impoundment may be due, among other things, to damming up and erosion. The length-weight relationship was good as compared with the trout of the nearby Lake Blasjon.

The flesh coloration was white in trout weighing less than 100 grams, and red in trout weighing more than 200 grams. The ecological characteristics of allopatric trout are discussed. (Auth. summ.)

9410. U.S. Bureau of Commercial Fisheries. 1967. REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, GULF BREEZE, FLORIDA. U.S. Fish and Wildlife Service Circular 260. 15 p.

The program of the Laboratory has been concerned since 1958 with evaluating the effects of pesticides—primarily synthetic organic chemicals—on marine plants and animals. Projects are designed to determine existing pollution levels, concentrations causing acute and chronic effects, and the translocation of residues in the biota and environment.

9411. Charnell, Robert L., David W. K. Au, and Gunter R. Seckel. 1967. THE TRADE WIND ZONE OCEANOGRAPHY PILOT STUDY. PART I. TOWNSEND CROMWELL CRUISES 1, 2, AND 3 FEBRUARY TO APRIL 1964. U.S. Fish and Wildlife Service, Special Scientific Report—Fisheries No. 552. 75 p.

A standard grid of oceanographic stations in an area bounded by lat. 10° and 26° N., and long. 148° and 157° W., was occupied at monthly intervals between February 1964 and June 1965. For the first set of three cruises, Townsend Cromwell cruises 1, 2, and 3, February to April 1964, oceanographic station data are tabulated, BT data are presented in vertical sections, and the distribution of surface temperature, surface salinity, and surface dynamic height relative to 1,000 m (cruise 1), and 1,200 m (cruises 2 and 3) are shown in charts for each cruise. Methods and procedures as well as the limitations of the data are discussed. (Authors)

9412. Corey, Bob (U.S. Trout Farmers Assoc., c/o Silver Springs Trout Farm, Montrose, Colo.). 1967. BRIGHT RAINBOW IN SKY...IF... American Fishes and U.S. Trout News, 12(1): 3, 26.

The President of the U.S. Trout Farmers Association believes that trout, to stock the complex of dams being constructed along tributaries of the Colorado River, could be produced by privately owned trout hatcheries at a much lower cost than the federal government can produce them. He proposes to determine the supply and the cost from private hatcheries and advise legislative representatives and appropriate government agencies of these data.

9413. Hovey, Larry (Times-News Sports Editor, Twin Falls, Idaho). 1967. IDAHO'S BIG STEELHEAD EXPERIMENT. American Fishes and U.S. Trout News, 12(1): 4-5, 24-26.

Description of the plans for transplanting the entire anadromous fish run from the Middle Snake to the Pahsimeroi River of the Salmon River drainage. The Idaho Power Company, awarded the federal license for Hell's Canyon Dam on the Middle Snake River, is financing the project.

9414. Kennedy, V.S., and J.A. Mihursky (Natural Resources Inst. of the Univ. of Maryland, Chesapeake Biol. Lab., Solomons, Md.). 1967. BIBLIOGRAPHY ON THE EFFECTS OF TEMPERATURE IN THE AQUATIC ENVIRONMENT. Natural Resources Inst., Univ. of Maryland, Contribution No. 326.

A bibliography containing 1220 entries has been compiled to aid biologists concerned with the effects of temperature on aquatic ecosystems. The entries mainly concern the biological aspects of high and low temperatures. A number of references concerned with engineering considerations and the beneficial uses of thermal discharges are included. The entries are alphabetical and the bibliography includes a subject index and phylum index. (Authors)

9415. Anonymous. 1967. GREENBACK TROUT. Colorado Outdoors, 16(1): 24-25.

Thought extinct, but recently discovered, is Colorado's "true" native trout—the greenback. Greenbacks taken during transplant operations averaged 6 to 10 inches and were 2 to 4 years old. The "true" Colorado native closely resembles

the native which most people are acquainted with, the Yellowstone cutthroat. Only visual difference is the larger spots on the tail section. In lab analysis, the greenback has fewer vertebra and more scales than the Yellowstone.

9416. Haertel, Lois, and Charles Osterberg (Dept. of Oceanography, Oregon State Univ., Corvallis, Oreg.). 1967. ECOLOGY OF ZOOPLANKTON, BENTHOS AND FISHES IN THE COLUMBIA RIVER ESTUARY. Ecology, 48(3): 459-472.

Fauna of the Columbia River estuary were sampled regularly for 21 months. Analyses of plankton samples indicated that three distinct populations existed in the estuary: a freshwater group, a marine group, and an indigenous estuarine group. The latter consisted principally of a large population of Eurytemora hirundoides. Changes in the salinity of the estuary were reflected in the composition of the plankton. The majority of the fish and benthic invertebrates found in the estuary are euryhaline. The largest numbers of fish species, as well as the largest numbers of individuals, occupy the slightly brackish waters of the central portion of the estuary. The major plankton blooms also occur in this area. Starry flounder (Platichthys stellatus) and sand shrimp (Crangon franciscorum) use the upper estuary as a nursery ground. Extensive analyses of fish stomach contents confirm that food habits of fishes generally reflect the availability of prey. (Authors)

9417. Yount, James L. (Florida State Board of Health, Winter Haven, Fla.). 1966. A METHOD FOR REARING LARGE NUMBERS OF POND MIDGE LARVAE, WITH ESTIMATES OF PRODUCTIVITY AND STANDING CROP. American Midland Naturalist, 76(1): 230-238.

A method for rearing large numbers of larval midges in plastic-lined ponds, with fertilization only, is presented. Estimates of standing crop and productivity of these midges are presented, along with comparative data on standing crop and productivity for other animals from the literature. (Auth.)

9418. Martin, R.O.R., and Ronald L. Hanson. 1966. RESERVOIRS IN THE UNITED STATES. U.S. Dept. of the Interior, Geological Survey Water-Supply Paper 1838. 115 p. Map.

This report summarizes the storage capacities and related data of reservoirs and controlled natural lakes for the conterminous United States, Alaska, Hawaii, and the Commonwealth of Puerto Rico. Data are given for all storage facilities having a usable capacity of 5,000 acre-feet or more and completed or under construction as of January 1, 1963. A descriptive list of reservoirs in the United States completed as of January 1, 1947, was first published (Geol. Survey Circular 23) in March 1948. In 1956 Water-Supply Paper 1360-A, "Reservoirs in the United States," by N.O. Thomas and G.E. Harbeck, Jr., updated this listing and included lists of reservoirs completed or under construction as of January 1, 1954. Some of the data shown for reservoirs constructed before 1954 may have been corrected herein on the basis of the latest available reservoir survey. This report lists 1,562 reservoirs and lakes; their usable storage totals 359,360,000 acre-feet, and the corresponding surface area is 14,831,000 acres. (Authors)

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